REPORT RESUMES

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AN INVESTIGATION AND DEVELOPMENT OF THE CLUSTER CONCEPT AS A PROGRAM IN VOCATIONAL EDUCATION AT THE SECONDARY SCHOOL LEVEL--FINAL REPORT, PHASE 1.
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THE INVESTIGATION AND DEVELOPMENT OF THE CLUSTER CONCEPT AS A PROGRAM IN VOCATIONAL EDUCATION AT THE SECONDARY SCHOOL LEVEL WERE REPORTED. THE "CLUSTER CONCEPT" PROGRAM IS AIMED AT THE DEVELOPMENT OF SKILLS AND UNDERSTANDINGS RELATED TO A NUMBER OF ALLIED FIELDS, AND WOULD PREPARE THE PERSON TO ENTER INTO A FAMILY OF OCCUPATIONS RATHER THAN A SPECIFIC OCCUPATION. REVIEW OF THE LITERATURE IN THE AREAS OF EDUCATION, LABOR, ECONOMICS, AND INDUSTRY HAS ESTABLISHED THE NEED FOR THIS TYPE OF PROGRAM. THE SUMMARIES WERE PRESENTED IN THREE SECTIONS--(1) APPROPRIATENESS OF THE CLUSTER CONCEPT PROGRAM, (2) DEVELOPMENT OF OCCUPATIONAL CLUSTERS, AND (3) DEVELOPMENT OF COURSE OUTLINES. (FOR THE COURSE OUTLINES SEE ED 010 303, ED 010 302, AND ED 010 304.) (GC)

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FINAL REPORT

(One of Four Volumes)

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AN INVESTIGATION AND DEVELOPMENT OF THE CLUSTER CONCEPT AS A PROGRAM IN VOCATIONAL EDUCATION AT THE SECONDARY SCHOOL LEVEL

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August 31, 1966

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PREFACE

Considerable encouragement has been expressed to vocational educators to be innovative and creative in their efforts to provide the kinds of education needed in the years ahead. This project is one of a number of similar attempts on the part of the profession. The cluster concept, as envisioned in this study, is designed to prepare the individual for entry level capability in a cluster of related occupations. The concept is aimed at the development of skills and understandings related to a number of allied fields as well as the specific job entry requirements.

The project was initiated for the purpose of making a study of the cluster concept as a form of vocational education at the secondary school level. The initial phase of the research was aimed at determining the acceptability and feasibility of the cluster concept approach as well as identifying certain occupational clusters. The final phase was directed toward developing a series of course outlines for the selected clusters. The cluster concept was not an attempt to establish a national, regional, or local program for vocational education. It was strictly a research effort aimed at the three aspects identified above.

The final report of the project is presented in four volumes. The first volume is a three part report. The first section presents the research procedures and results concerning the appropriateness of the cluster concept. The second section presents the research procedures and results concerning the identification of occupational clusters. The third section presents the research procedures used to develop the course outlines for the identified occupational clusters.

The other three volumes present the results of the project for each of the following occupational clusters: construction, electro-mechanical installation and repair, and metal forming and fabrication. Each of these volumes is divided into five sections. The first section presents the tasks identified for job entry into the occupations included in the specific clusters. The second section includes the analysis of the tasks, or worker activities, with respect to the areas of human requirement needed to perform the tasks. An instructional sequence example for each task is provided in the third section. The fourth section presents the common areas of human requirement for the cluster and the last section presents the course outlines for the occupational cluster.

The research was performed by a research team under the direction of Dr. Donald Maley, Professor and Head of The Industrial Education Department at The University of Maryland. The project was coordinated by Nevin R. Frantz, Jr. In addition to the research team, many other individuals (see Appendix D) contributed significantly to the project in a variety of ways. Their efforts on behalf of the project are gratefully acknowledged.

PERSONNEL FOR THE PROJECT

The following personnel were involved in the research and development of the project on the cluster concept as a program in vocational education at the secondary school level:

PRINCIPAL INVESTIGATOR

Dr. Donald Maley

PROJECT COORDINATOR

Mr. Nevin Frantz, Jr.

RESEARCH ASSISTANTS

Electro-Mechanical Installation and Repair Cluster

Mr. Andrew Baron
Mr. Morris Lay

Construction Cluster

Mr. Kenvyn Richards
Mr. Richard Spahr

Metal Forming and Fabrication Cluster

Mr. David Mills

GRADUATE ASSISTANTS

Mr. Edwin Boyer (Summer 1966)
Mr. Edwood Bunch (Summer 1966)
Mr. Kenneth Stough (Summer 1966)

SECRETARIES

Mrs. Betty Wilson
Mrs. Nancy Bunch (Summer 1966)

ACTIVITIES OF THE PROJECT

The following is a listing of activities engaged in by the research personnel:

1. The project was iniated with the development of a brochure which was used to describe the project and its objectives.
2. A series of visual aids were produced and used in conjunction with the interviews and the communication of the basic ideas in the study.
3. Slides were made of the visual aids and were used in presenting the cluster concept approach to the groups who expressed an interest in the project.
4. A series of ten pilot interviews were held with individuals representing education, labor, and industry to determine the procedures and techniques to be utilized in the interview-survey phase of the research.
5. A group of fifty individuals were contacted by letter and thirty-one of the fifty initially contacted were then interviewed to determine the acceptability and feasibility of the cluster concept program.
6. Weekly seminars and discussion groups were held to clarify the direction of the project and develop procedures for accomplishing special objectives. During many of these meetings, guests and consultants were invited from the Industrial Education Department at the University of Maryland, The Department of Labor, The Maryland State Department of Education and the College of Education at the University of Maryland.
7. A series of visits to approximately fifty manufacturing plants, construction sites, repair service businesses and labor union headquarters, were made by members of the project team in order to obtain information about occupational requirements.
8. A conference involving a total of thirty people representing management and labor was held to determine tasks that are required for successful entry into an occupation.

9. A collection of over four hundred pieces of literature in the areas of manpower, employment, curriculum, job analysis, and skill requirements has been obtained and catalogued by the research team.

10. Approximately two hundred and fifty courses of study have been purchased from all sections of the country.

11. A library of approximately fifty textbooks have been donated to the project by publishing companies contacted by the research team.

12. The project was formally presented by the principal investigator, project coordinator, and research assistants to the following groups:

    (1) Education classes at the University of Maryland
    (2) Cecil County Economic Development Commission
    (3) Prince Georges County Kiwanis Club
    (4) Conference held with representatives from labor and management at the University of Maryland for the purpose of identifying job entry tasks
    (5) Research Conference on Vocational-Technical Education held at the University of Wisconsin
    (6) Annual meeting of the Maryland Vocational Asociation
    (7) U. S. Army personnel located at the Aberdeen Proving Ground

13. A mailing list of over 300 individuals has been developed. Many of these individuals have expressed an interest in keeping abreast of any developments and information produced by the cluster concept research project.

ABSTRACT OF THE PROJECT

The following is a brief summary of the "Cluster Concept" project following the outline as suggested by the U. S. Office of Education for such projects:

Grant Number: OE 685-023

Title: An Investigation and Development of the Cluster Concept as a Program in Vocational Education at the Secondary School Level

Principal Investigator: Dr. Donald Maley

Institution:
Industrial Education Department
University of Maryland
College Park, Maryland

Duration: September 1, 1966 to August 31, 1967

Objectives and Procedures: The following objectives and research procedures were identified for investigating and developing the cluster concept as a program in vocational education at the secondary school level.

OBJECTIVE A. An investigation was made to determine the appropriateness of the cluster concept as a program in vocational education at the secondary school level.

The following procedures were utilized:

1. An extensive search was made of the literature in the areas of education, labor, economics, and industry to obtain an indication of the need for a cluster concept program.
2. A series of interviews with individuals representing industry, education, and labor was conducted in order to obtain an indication of the acceptability and feasibility of a cluster concept program.

3. A continuous dialogue was carried on throughout the year between the research team and persons from labor, business, industry, and education in an attempt to obtain perspective and as broad a reaction as possible.

4. An analysis was made of the data obtained from the interviews and the review of literature to determine the need, acceptability, and feasibility of the cluster concept.

OBJECTIVE B. An investigation was made to identify occupational clusters and the specific occupations in each cluster that will be suitable for a cluster concept program in vocational education at the secondary school level.

1. A review and evaluation of research in the area of occupational grouping was conducted to determine possible applications for the project.

2. A method of research, based upon a sampling technique proposed by Altman and Gagne of the American Institutes for Research, was developed to determine occupational clusters.

    a. A list of criteria were prepared to use in selecting occupational clusters and specific occupations within the clusters.

    b. A group of possible occupational clusters was developed and several clusters were selected from the group for further analysis.

    c. A number of possible occupations were developed for each cluster and those occupations meeting the established criteria were selected for further analysis.

3. A group of three occupational clusters with their respective selected occupations was identified for further analysis.

OBJECTIVE C. An investigation was made to develop a series of course outlines for a cluster concept program in vocational education at the secondary school level.

1. A review of research was conducted to determine methods of analyzing the selected occupations in order to identify the common areas of human requirement needed for each occupational family.

2. A method based upon a procedure proposed by Smith of the Human Resources Research Office, was developed to analyze each occupation in the cluster.

    a. A list of tasks was developed for each occupation through a review of training manuals, courses of study, textbooks and interviews with representatives from each occupation.

    b. A task identification inventory was developed and submitted to a group of individuals representing the selected occupations in order to determine job entry tasks.

    c. The identified job entry tasks were analyzed to determine the areas of human requirement (skills, mathematics, measurement, science, communication, and information) needed to successfully perform the tasks.

3. An analysis technique, based on a study by Miller and Folley, was used to identify the common areas of human requirement within each occupational cluster.

    a. The areas of human requirement were examined to determine the commonalities that existed among the occupations within the cluster.

    b. Judgements were made by project personnel to select the common areas of human requirement required for performance of the occupations within the occupational clusters.

4. A course of study for each occupational family was developed from the identified common areas of human requirement and task analysis.

Results and Conclusions: The results and conclusions with respect to the appropriateness of the cluster concept include the following areas: (1) the need for a cluster concept program, (2) the acceptability of a cluster concept program, and (3) the feasibility of a cluster concept program.

The review of literature in the areas of education, labor, economics, and industry has established the following needs for the Cluster Concept Program:

1. There is a need to provide students with a greater degree of mobility on a geographical basis.
2. There is a need to provide students with mobility for jobs within an industry or occupation.
3. There is a need to develop students who will be able to adapt to technological change.
4. There is a need to provide students with greater flexibility in occupational choice patterns.

A series of interviews with individuals representing industry, education, and labor was conducted in order to obtain an indication of the acceptability and feasibility of a cluster concept program. A group of fifty persons, including personnel managers, training directors, county superintendents of schools, industrial education supervisors, local union presidents and business managers, were contacted for an interview. A response was obtained from thirty-seven individuals representing seventy-four percent of the total contacted. Thirty-one persons of the thirty-seven responding were interviewed representing sixty-two percent of the total number of individuals contacted.

From the total of thirty-one persons interviewed, twenty-nine individuals, representing ninety-four percent of the total interviewed, indicated the program was acceptable. Acceptability was defined as an interviewee being in favor of the cluster concept as a program in vocational education on the secondary school level.

The general reaction from the individuals interviewed indicated that students with a cluster concept background would be excellent potential employees and would be less difficult to train because of their broad, fundamental background. A desire for employees to obtain a "good attitude" toward their job appeared to be the most important concern of management. The opportunity for students to become acquainted with the requirements of several occupations was considered by management to play an important role in the formation of proper attitudes.

A total of twenty-five persons, representing eighty-one percent of the number interviewed, indicated that the cluster concept as a program in vocational education on the secondary school level was feasibile. Feasibility was defined as an interviewee indicating the cluster concept program is capable of being implemented successfully.

The general reaction from the individuals interviewed indicated that the cluster concept was feasible and could be implemented in the secondary schools with little difficulty.

Representatives from labor and industry indicated that students with a cluster concept background could obtain employment and would be able to advance and specialize through on-the-job training and apprentice programs.

The development of occupational clusters with their specific occupations was initiated by analyzing the results of previous studies in the areas of occupational classification. After reviewing several occupational classification systems, the conclusion was reached that the occupational clusters and their specific occupations could best be developed from a list of criteria. The following criteria were established for the purpose of identifying occupational clusters and their specific occupations.

The occupational cluster should:

1. Be in the area of vocational industrial education.
2. Include occupations that are related on the basis of similar processes, materials, and products.
3. Be broad enough to include occupations with a wide variety of skills and knowledge.
4. Involve occupations that require not more than a high school education and/or two years beyond high school.
5. Provide the opportunity for mobility on a geographical and occupational basis.

The occupations in each cluster must have:

1. A favorable employment outlook.
2. The instructional capability of being implemented in a secondary school program.
3. Opportunity for job entry upon graduation from high school.
4. Numerous skills and knowledge providing an opportunity for the identification of commonalities with other occupations.
5. Opportunities for advancement through further schooling, on-the-job training, or apprentice programs.

As a result of applying the criteria to a group of possible occupational families and specific occupations within the groupings, the following clusters with their respective occupations were established:

Electro-Mechanical Installation and Repair Cluster

1. Business Machine Serviceman
2. Home Appliance Serviceman
3. Radio and Television Serviceman
4. Air Conditioning and Refrigeration Serviceman

Metal Forming and Fabrication Cluster

1. Welder
2. Machinist
3. Sheet Metal Worker
4. Assembler

Construction Cluster

1. Carpenter
2. Mason
3. Plumber
4. Electrician
5. Painter

An analysis was made of the occupations with respect to the following areas of human requirement:

1. Communications
    - Vocabulary
    - Symbols
    - Drawings and blueprints
    - Systems of communication
    - Speech
    - English
    - Maps
2. Measurement
    - Time
    - Temperature
    - Weight
    - Volume
    - Length, width, and depth
    - Meters (electrical and mechanical)
    - Instruments
    - Systems of measurement
3. Skills
    - Hand
    - Mental
    - Machine
4. Mathematics and Science
5. Information
    - Technical
    - Operational
    - Occupational
    - Economic
    - Social
    - Safety
    - Personnel standards
    - Occupational and job standards

A series of course outlines were developed from the analysis of the occupations and the identification of common areas of human requirement in each occupational cluster. The course outlines were developed for the occupational clusters of construction, metal forming and fabrication, and electro-mechanical installation and repair.

PART I REPORT

APPROPRIATENESS OF THE CLUSTER CONCEPT PROGRAM

A. Introduction

The first section of the three part final report is concerned with the appropriateness of the cluster concept as a program in vocational education at the secondary school level. The section will address itself to the need, acceptability, and feasibility of a cluster concept program according to the evidence obtained by the research team.

B. Explanation Of The Cluster Concept Program

The "cluster concept" is aimed at the development of skills and understandings related to a number of allied fields. The skills and understandings would be common to a number of the occupations in the field. However, it is not an in-depth development into any one job. The "cluster concept" differs from the conventional vocational programs in terms of scope and depth. The usual vocational program is designed to prepare the individual for a specific job such as a pattern-maker, auto mechanic, or plumber.

The "cluster" type of program would prepare the person to enter into a family of occupations rather than a specific occupation. Examples of cluster occupational groups could include the medical and health occupational cluster, the food services cluster, construction cluster, or a metal fabrication cluster.

C. Research Procedures

The following procedures were utilized in determining the appropriateness, acceptability, and feasibility of the Cluster Concept as a Program in Vocational Education:

1. An extensive search was made of the literature in the areas of education, labor, economics, and industry to obtain an indication of the need for a cluster concept program.
2. A continuous surveillance and collection of information was made of research studies and existing programs similar to the cluster concept.
3. A continuous dialogue was carried on throughout the year between the research team and persons from labor, business, industry, and education in an attempt to obtain perspective and as broad a reaction as possible.
4. A series of interviews with individuals representing industry, education, and labor was conducted in order to obtain an indication of the acceptability and feasibility of a cluster concept program.
5. An analysis was made of the data obtained from the interviews and the review of literature to determine the need, acceptability and feasibility of the cluster concept program.

D. Need For A Cluster Concept Program

A review and analysis of the literature in the areas of education, labor, economics, and industry has established the following needs for the cluster concept program. The following quotations are representative of the fifty supportive bibliographical entries obtained from a review of approximately one hundred and fifty publications.

1. There is a need to provide students with a greater degree of mobility on a geographical basis.

The Bureau of Census reported:

> Of the 185.3 million persons 1 year old and over living in the United States in March, 1964, 36.3 million, or 19.6 percent, had been living at a different address in the United States in March, 1963...The peak mobility rate occurred among persons in their early twenties- the age at which most young people leave their parental home to find employment...[1]

An implication for vocational education with reference to geographical mobility of the population was proposed by Kimball Wiles:

> Vocational education can no longer be planned solely in terms of the community in which a high school exists. Over half of the average school's graduates will migrate to another community, and will go to another state. Seemingly the wisest step for curriculum planners to take, then, is to study industrial and commercial operations and plan in terms of clusters of competencies. When a student has developed a particular set of abilities he may enter a variety of related occupations.[2]

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[1] U. S. Department of Commerce, Bureau of the Census, "Mobility of the Population of the United States, March 1963 to March 1964," Current Population Reports: Population Characteristics, September 7, 1965, Census Publication Series P-20, No. 141 (Washington: Government Printing Office, 1965), p. 1.

[2] Kimball Wiles, The Changing Curriculum of the American High School (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1963), p. 126.

The importance of mobility, on a geographical basis, was further emphasized by Grant Venn:

> Work mobility is important to occupational well-being and competence in an economy increasingly subject to technological dislocation. A company moves to a new state; the award of a government contract causes thousands of jobs to be shifted from one state to another; a new invention wipes out an industry by making it obsolete; whole occupations and job titles are created and abolished--these and other phenomena mark the extent to which occupational education must prepare people to face change. The labor force needs to maintain a high degree of mobility, ability to move from one place to another, and from one job to another. Current rates of occupational and geographical mobility are high, but they are relatively low for the future needs of technology and are misleading as an indication of purpose and direction. [3]

2. There is a need to provide students with mobility for jobs within an industry or occupation.

The Bureau of Labor Statistics has found that "during 1961, some 8 million workers--10 percent of the number who worked--shifted from one employer to another..."[4] The rate of job changing in 1961 was highest among men and women between the ages of 18 and 24 who were largely unskilled and had little education.[5]

---

[3] Grant Venn, Man Education and Work (Washington, D. C.: American Council on Education, 1965), p. 130.

[4] Gertrude Bancroft and Stuart Garfinkle, "Job Mobility in 1961," Special Labor Force Report, No. 35. (Washington: U. S. Department of Labor, Bureau of Labor Statistics, 1963), p. 2.

[5] Ibid.

An implication for the nature of vocational education was proposed by James E. Russell in the publication Automation and the Challenge to Education:

> ...therefore, to the extent that the school tries to develop employable skills, it should aim at transferable skills, and it should not attempt to train persons for specific jobs that are only temporarily open.[6]

In terms of the requirements of industry, Rumpf has stated that:

> Industry needs workers who are flexible, workers who have a field of skills and basic education that will enable them to adapt rapidly to occupational changes. Workers who are adaptable make installation of new methods and equipment more economical for employers. Management needs workers ready to move into its jobs without long periods of preparation.[7]

3. There is a need to develop students who will be able to adapt to technological changes.

The Department of Labor estimated that about 200,000 non-agricultural workers per year will be displaced because of technological change during the next decade.[8] In five case studies on the

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[6] James E. Russell, "Educational Implications of Automation as Seen by an Educational Policy Planner," Automation and the Challenge to Education, Proceedings of a symposium sponsored by the Project on the Educational Implications of Automation (Washington: National Education Association, 1962), p. 42.

[7] Edwin L. Rumpf, "Training the Manpower Catalyst," Manpower and Training Needs of the Food Industry, Report of a National Conference, April 22-24 (Washington: Government Printing Office, 1964), p.10.

[8] Bancroft and Garfinkle, loc. cit.

> effects of plant layoffs and shut-downs, it was found that in each case technological change was a factor in worker unemployment.[9]

The future need to develop students of this caliber was further stressed in the Manpower Report of the President:

> Growth and change have characterized the American economy throughout our history, and continual adjustments to shifting manpower requirements by workers, employers and training institutions have been the rule rather than the exception. Thus, the significant changes in patterns of demand for blue-and-white-collar workers, for the skilled and less skilled, and for men and women workers since World War II were no new phenomena. The persistence of the under-lying factors--rising levels of living, associated shifts in consumer purchases, changes in government demand, technological innovations, and productivity growth--implies continued patterns of change in manpower demand.[10]

Peter Drucker, in an address given at the State University College, Oswego, New York, further supported this need:

> A reason why technological education needs to be a part of a general education is that it is no longer of much use to teach any one craft as such. Crafts change too fast. When I was a child forty years or so ago it was quite obvious that anybody who had ever learned a craft had learned enough for the rest of his life. This applied not only to the carpenter or the house painter but to the lawyer and doctor just as well. But today the one thing that is predictable about any craft is that in its present form it is not going to stay around very long. The good Lord did not ordain the crafts. They are man-made and therefore can be altered by man. Crafts that seemed to be as solid as the glacier granite of Upstate New York are dissolving all around us. We

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[9] Ewan Clague and Leo Greenberg, "Technological Change and Employment," Monthly Labor Review, 85:741-746, 1962.

[10] U.S. Department of Labor, Manpower Report of the President. (Washington: Government Printing Office, 1965), p. 45.

> will see for instance, predictably in the next twenty years or so, a complete change of the graphic arts crafts in which not one will remain the way it is. One can also say that this will not mean fewer skilled people, but it will mean people with different skills.[11]

Thomas Brooks supports this need on the basis that the chief traits in demand today are adaptability and versatility:

> "It is not uncommon," says a foundry manager, for a man to work on twenty different jobs a year. We take advantage of change in work flow, absences and other factors to move our people around."[12]

An implication for vocational education relative to the impact of technological change was found in the Rockefeller Report on Education:

> In this day of technologies that become antiquated overnight, it is hazardous to predict a favorable future for any narrow occupational category. There will be economic advantage to the individual in acquiring the kind of fundamental training that will enable him to move back and forth over several occupational categories.[13]

4. There is a need to provide students with greater flexibility in occupational choice patterns.

Eli Ginzberg has stated that occupational decision-making can be divided into three distinct periods:

> The period during which the individual makes what can be described as a fantasy choice; the period during which he is making a tentative choice;

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[11] Peter Drucker, "Knowledge and Technology," (an address delivered at the State University College, Oswego, New York, May 6, 1964).

[12] Thomas R. Brooks, "The Blue Collar Elite," Dun's Review and Modern Industry, Special Supplement-Part II, March 1964, p.122.

[13] Rockefeller Brothers Fund, Inc., The Pursuit of Excellence, (Garden City, New York: Doubleday and Company, 1958), p. 10.

> and the period when he makes a realistic choice. The first coincides in general with the latency period, between six and eleven, although residual elements of fantasy choices frequently carry over into the preadolescent years. The second coincides by and large with early and late adolescence with a few exceptions, realistic choices are made in early adulthood. To some degree the way in which a young person deals with his occupational choice is indicative of his general maturity, and conversely, in assessing the latter, consideration must be given to the way in which he is handling his occupational choice problem.[14]

Baer and Roeber have commented as follows on the advisability of preparation for several occupations:

> Since most young people have a broad range of interests and capabilities, appropriate initial choices are facilitated by a knowledge of families of occupations. It is becoming more generally recognized that early training, even at the college level, should be broad enough to give the student the background for a group of related occupations. Thus, he is not driven into a specific occupational choice before his interests have matured sufficiently for him to enter the job market, his chances of successful placement are increased if he is prepared to begin at any one of several jobs in a given field of work. If this field happen to be commercial art, for example, he could become a poster artist, sign writer, catalog illustrator or layout man. Once hired, he has a better chance of promotion if he has been trained for a group of related occupations. Should he lose his job as a result of adverse business conditions or obsolescence of the occupation, he can switch to another job in the same occupational family.[15]

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[14] Eli Ginzberg, Occupational Choice (New York: Columbia University Press, 1963), p. 60.

[15] Max Baer and Edward C. Roeber, Occupational Information (Chicago: Science Research Associates, 1964), p. 167.

The final report of the panel of consultants on vocational education appointed by the Secretary of Health, Education, and Welfare contained the following recommendation:

> Basic vocational education programs should be designed to provide education in skills and concepts common to clusters of closely related occupations. The curriculum should be derived from analyses of the common features of the occupations included. These students should receive specialized or more advanced vocational training later in post-high school programs, apprenticeship, or on-the-job experiences.[16]

E. Related Studies

A review of research in the areas of psychology, education, and military training have revealed a number of studies related to the Cluster Concept Project.

A study was conducted by Dauwalder to produce recommendations for redesigning the vocational program of the Pittsburgh Public School system. An analysis of industrial employment requirements in Pittsburgh and in other parts of the nation indicated that:

> . . . more than 50 percent of all subject matter necessary to qualify for entry level employment is common throughout all the jobs within a family grouping. For example, all technical jobs require similar knowledge to at least the extent of 50 percent of the over-all curriculum. In a like manner, all semi-skilled jobs have at least 50 percent of the knowledge required in common. This applies to all job families.[17]

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[16] U.S. Department of Health, Education and Welfare, Office of Education, Education for a Changing World of Work. (Washington: Government Printing Office, 1963), p. 227.

[17] Donald D. Dauwalder, Vocational Education in the Pittsburgh Public Schools (Pittsburgh: The Pittsburgh Board of Public Education, April, 1963), p. 57.

A project directed by McCloskey at Washington State University has been investigating the development of task and knowledge clusters by using an interview-assessment instrument in consultation with industry and labor. These interview-assessment instruments are being used in the following areas: office occupations, food and child care service occupations, electronics, agricultural and related occupations, and building trades occupations.[18]

A project identifying common courses in paramedical education is being conducted by Lee, Fullerton, and Fetterhoff at Arizona State University. A review of existing courses from hospitals and medical institutions throughout the country were reviewed. A detailed analysis of the course content was made and common courses were identified which formed the basis for the preparation of guidelines for the integration of paramedical education programs with common courses.[19]

Gordon L. Bratt of the Canadian Department of Labor, is making a functional analysis of the requirements of the total industrial scene in Canada. Selected industries are broken down into four levels of technical capability: Professional occupations, technology occupations, craft occupations, and operative or semi-skilled occupations. All of the jobs within a particular industry are then placed into one of these four levels. Each job in the industry is then analyzed with respect to the functions which people are expected to perform and occupational categories are developed on the basis of their affinity, in terms of technical capability to each other. This type of research will provide the foundation for technical education and training programs aimed at developing transferability of technical capability, mobility within the work force, and versatility to minimize future retraining.[20]

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[18] Gordon McCloskey, "Proposal for 18-Month Continuation of Vocational-Technical Education Research and Development Project" (unpublished research proposal, Washington State University, Washington State Board of Education, Pullman, Washington and the University of Idaho, Idaho State Board for Vocational Education, Moscow, Idaho, 1966).

[19] Arthur M. Lee, William J. Fullerton, and Willard M. Fetterhoff, "The Identification of Common Courses in Paramedical Education," (unpublished research proposal, Arizona State University, Tempe, Arizona, 1966).

Gagne and Altman at the American Institutes for Research have investigated general vocational capabilities under a grant from the Ford Foundation. Thirty-one occupations were selected and a random sample of task behaviors was drawn for each occupation. The task behaviors were then translated to multiple-choice test items. The tests were administered to 10,000 students, grades nine through Junior College. After a series of analyses of correlational patterns and mean sex differences, the following areas emerged as a relatively well-structured domain of general vocational capabilities as defined by the tests used: Mechanical, Electrical, Spatial, Chemical-Biological, Symbolic, and People (Human Relations).[21]

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[20] Letter, Gordon L. Bratt to Nevin Frantz, March 18, 1966.

[21] James W. Altman, Final Report on General Vocational Capabilities (Skills and Knowledges) (Pittsburgh, Pennsylvania: American Institutes for Research, 1966).

Schill and Arnold conducted a study to determine curricula content for six technologies at The University of Illinois. The six technologies (related occupations) studied in this program were: electronics, electro-mechanical, mechanical, chemical-mechanical, chemical, and electro-chemical.

The basic instrument used to collect data on technical occupations was a modified Q-sort technique. A group of cards, each having a description of a course taken by technicians in preparation for various jobs was developed.

Analyses used in forming conclusions were the one-way analysis of variance, and the principle components of factor analysis. Knowledge found to be common to all technologies included: technical writing, engineering graphics, mathematics through trigonometry, and the use of test equipment.[22]

The Human Resources Research Office conducted a study to determine a system of performing generalized training research. The training requirements for approximately one half of all the army enlisted jobs were analyzed on the basis of shared functional themes. A system of twenty functional categories, under three broad classes of: equipment operation and maintenance, tactical systems, and a general area were identified.

A smaller sampling of jobs were then analyzed and each job requirement was divided into three component parts: subject matter, subject-matter modifier, and proficiency involved. The analyzed requirements were then coded and the lists of subject matters and proficiencies involved were scanned and each "basic idea" was identified. Examples of "basic ideas" include trouble shooting, safety, maintenance/maintaining, and operation/operaing.

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[22] William J. Schill and Joseph P. Arnold, Curricula Content for Six Technologies (Urbana, Illinois: Bureau of Educational Research and the Department of Vocational and Technical Education, University of Illinois, 1965).

The degree of generality of the basic ideas within the selected job population was then determined. Of the 443 ideas isolated by the analysis, sixty-four affected at least ten percent of the selected population of jobs.[23]

A study by Courtney at Stout State University is being conducted to identify and compare common training needs and requirements for teachers of vocational education. A survey instrument and personal interview are being used for the collection of data. A factor analysis technique will be used to determine the common core of training needs.[24]

F. Related Programs

Numerous requests and exchanges of information from individuals throughout the country have indicated the existence or development of several programs similar to the cluster concept approach.

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[23] Francis E. Jones, A Systematic Analysis of Army Training Requirements as the Basis of More Generalized Training Research, Research Report (Washington, D. C.: The George Washington University, Human Resources Research Office operating under contract with The Department of the Army, May, 1961).

[24] Wayne Courtney, "The Identification and Comparison of the Common Training Needs and Requirements for Teachers of Vocational Education" (unpublished research proposal, Stout State University, Menomonie, Wisconsin, 1966).

Occupational, Vocational, and Technical Education, designed to develop competency in a specific occupation within a job centered program, are being provided for students in the public schools of Pittsburgh, Pennsylvania. The job centered programs include the occupational areas of: accounting, business, communications, clothing and textiles, construction, electrical, foods-nutrition, information and data processing, manufacturing, merchandising, repair services, science, social and individual services, transportation and visual communications. The OVT programs are placed in comprehensive high schools rather than vocational schools enabling a student to follow a skill-centered program as well as a program for college entrance.[25]

An experimental curriculum is being developed for the Quincy, Massachusetts Vocational-Technical School under the direction of Edward V. Morrision of The American Institutes For Research. Eleven job families were chosen for emphasis in the Quincy Program and each selected representative job within the family has been analyzed in terms of the major tasks each job requires. The required tasks have been further analyzed to determine the skills and knowledges required for performing the job successfully. On the basis of this information, a panel of individuals have developed objectives for a vocational curriculum which incorporates the goals of (a) vocational competence, (b) responsible citizenship, and (c) individual self-fulfillment.[26]

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[25] Jerry C. Olson, "The Marriageability of Vocational Educational Education," School Shop, 25:39, October, 1965.

[26] Development and Evaluation of an Experimental Curriculum for the New Quincy (Mass.) Vocational-Technical School, First Quarterly Technical Report (Pittsburgh: American Institutes for Research, 1965).

The Vocational Program for the Job Corps is a tri-level program which consists of five phases of instruction. Phases I and II of the Exploration Program, consist of initial guidance and counseling. Phases III and IV of Pre-vocational Program is aimed at an introduction to seven vocational clusters. These phases give a student an opportunity to further explore the occupational clusters of automotives, clerical, culinary arts, conservation, general construction, maintenance, and medical. The student, who has a high degree of ability or previous vocational training, can enter an advanced occupational area for specialized training either before or after completing phase IV. The other students, after having been exposed to the seven clusters of occupations, will select a specific job in one of the clusters such as a service station attendant in the automotive cluster.[27]

The galaxy approach toward teaching vocational education, in the Detroit Public Schools, consists of four clusters of occupations. These clusters, or galaxies, consist of: materials and processes, visual communications, energy and propulsions, and personal services. The student experiences three phases to complete his training. Phase I consists of preliminary exploratory experiences in grades seven through nine with 75 percent of the contents in the area of basic education. In phase II, the

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[27] Office of Economic Opportunity, Work Education Program Manual (New York: Educational Design, Incorporated, 1965).

the tenth grade student is allowed to explore vocational opportunities in a more limited number of occupations. Most students in phase III are capable of selecting a specific galaxy of occupations to study in grades eleven and twelve, which will provide students with saleable skills.[28]

North Carolina has initiated an "industry series" which consists of courses called the "introduction to industry" program. A number of occupationally oriented courses, each covering a family of occupations within a specific area of industry, are designed to provide the opportunity for students in the tenth grade to investigate and learn about opportunities that exist in several areas. These areas or occupational families include: automotives, ceramics, construction, electrical, fishing, furniture, graphic arts, personal services, textiles, and metals. In-depth occupational competency is achieved during the eleventh and twelfth grades in the trade and industrial or industrial-cooperative-training program.[29]

Michigan State University, through its research and development program is developing an interdisciplinary approach to preparatory education and occupational training in the hospitality industries. The basic purpose of the program, at the eleventh and twelfth grade levels, will be to intergrate specific occupational training and basic education offerings to strengthen the student's potential development should he enter industry upon graduation. Considerable emphasis is placed on making the general education courses directly related to the occupation that the student has selected.[30]

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[28] Carl H. Turnquist, "Galaxy Approach to Education For The World of Work," Industrial Arts and Vocational Education, 25: 25, November, 1965.

[29] Charles D. Bates, "North Carolina's State-Wide Program---Introducing Students to Industry," Industrial Arts and Vocation-Education, 25:58, April, 1966.

Walter E. Erdkamp, State Director of Trade and Industrial Education for the State Department of Education in Nebraska has reported that his state has conducted two pilot programs making use of the cluster concept, and that two additional programs will begin during the Fall of 1966. These programs are oriented to prepare the student for the "world of work," as well as the "social world," by presenting a curriculum based on clusters such as: measurements, material, overhaul and repair, and industrial relations and safety.[31]

The University of Missouri is conducting a research project in cooperation with the public schools of St. Louis, concerning the study of "job families." This study closely parallels grouping of occupations under the cluster concept. The Missouri study is a three phase program which includes:

(1) Analyzing job families (groups of closely related occupations)

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[30] "Pilot Programs in Hospitality Occupations," (unpublished research proposal, Michigan State University, East Lansing, Michigan, 1966).

[31] Letter, Walter E. Erdkamp to Dr. Donald Maley, May 20, 1966.

(2) Organizing common elements into a program to be presented at the pre-employment level

(3) Following up graduates of this new program for five years by comparing their experience, success and satisfaction with a similarly structured group of students who were taught by conventional methods.[32]

The public school system of Gary, Indiana is developing curriculum for vocational education based on the cluster concept approach. Ten clusters have been selected from the census classifications for available jobs in the Gary area.[33]

G. Interviews

A series of interviews with leaders in industry, education, and labor was conducted to ascertain the acceptability and feasibility of the Cluster Concept Program. The interview survey was exploratory in nature rather than definitive and no attempt was made to randomly select the interviewees or to develop a highly structured interview instrument. A series of pilot interviews was held with appropriate individuals in selected local industries, labor unions, and employment security agencies. A set of interview questions and a series of visual aids were developed to facilitate the gathering of information.

Upon completion of the pilot interviews a list of possible interviewees was developed by reviewing: (a) industry lists furnished by county economic development commissions in the State of Maryland, (b) the membership list of the Maryland Society of

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[32] Letter, W. R. Miller to Dr. Donald Maley, March 2, 1966.

[33] Letter, Louis A. McElroy to Nevin R. Frantz, July 6, 1966.

Training Directors, (c) a Directory of School Officials in the State of Maryland and (d) labor unions listed in the Baltimore phone directory. A final selection of fifty individuals to be interviewed was made based on the following criteria:

(1) The appropriateness of the industry, labor union, or school district with respect to occupational clusters tentatively identified - (a) electronics and electricity, (b) construction, (c) mechanical and fabrication, (d) repair, service and maintenance.

(2) Number of persons in the industry, labor union, or school district with whom the interviewee if affiliated.

(3) Georgraphical representation of the interviewee in the State of Maryland.

The fifty persons selected for interviewing included personnel managers, training directors, county superintendents of schools, industrial education supervisors, local union presidents, and business managers. These individuals were sent an introductory letter, a pamphlet describing the cluster concept, and a self-addressed post card. It was requested that the post card be returned to the project coordinator to indicate whether the individual was interested in being interviewed. Of the fifty persons contacted, thirty-seven individuals responded, and thirty-one of these people agreed to be interviewed. Those persons agreeing to be interviewed represented sixty-two percent of the total contacted. The composition of the group of thirty-one persons to be interviewed included: sixteen from industry, eleven from education, and four from the field of labor. The interview request results are illustrated in Figure 1.

Research assistants from the Cluster Concept Project conducted the interviews at the respondents place of business at a prearranged time. The interviews were conducted in an informal unstructured manner using the set of visual aids to explain the project and the prepared set of questions as a guide in gathering the information. These interviews were tape recorded as agreed upon in the original letter requesting the interview. After returning from the interview, the research assistant replayed the tape and made his report according to an established, uniform format.

From the total of thirty-one persons interviewed, twenty-nine individuals representing ninety-four percent of those interviewed, indicated that the cluster concept program was acceptable. Acceptability was defined as an interviewee being in favor of the cluster concept as a program in vocational education at the secondary school level. The acceptability results are illustrated in Figures 2 and 3.

A total of twenty-five persons, representing eighty-one percent of the number interviewed, indicated that the cluster concept as a program in vocational education on the secondary school level was feasible. Feasibility was defined as an interviewee indicating the cluster concept program is capable of being implemented successfully. The feasibility results are illustrated in Figures 2 and 4.

Fourteen of the sixteen individuals interviewed from industry indicated that the program was acceptable. Those individuals who felt the program was acceptable indicated that they would like to hire someone with a cluster concept background and these persons would be excellent potential employees because of the flexibility provided in their training.

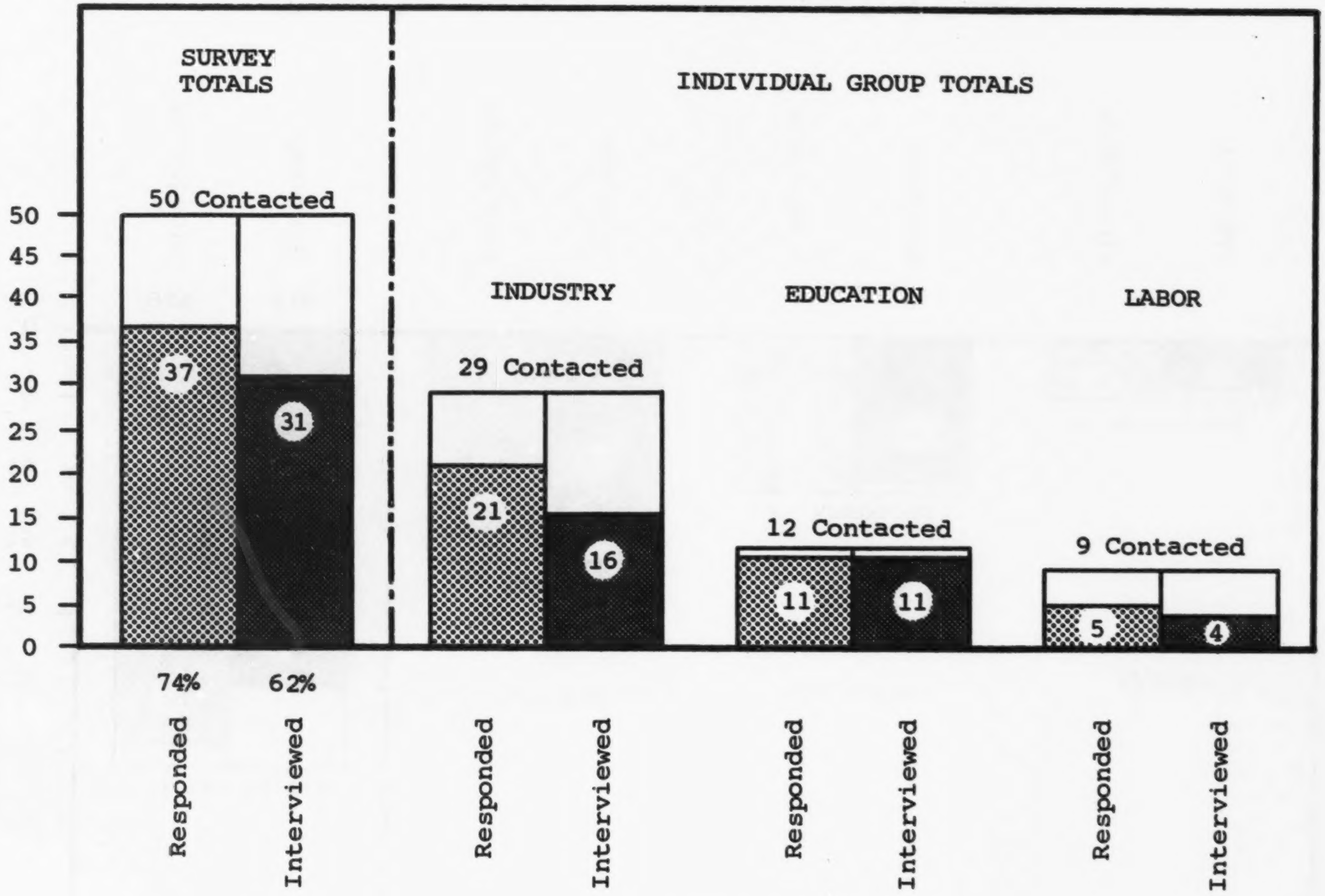

Figure 1. Interview Request Results

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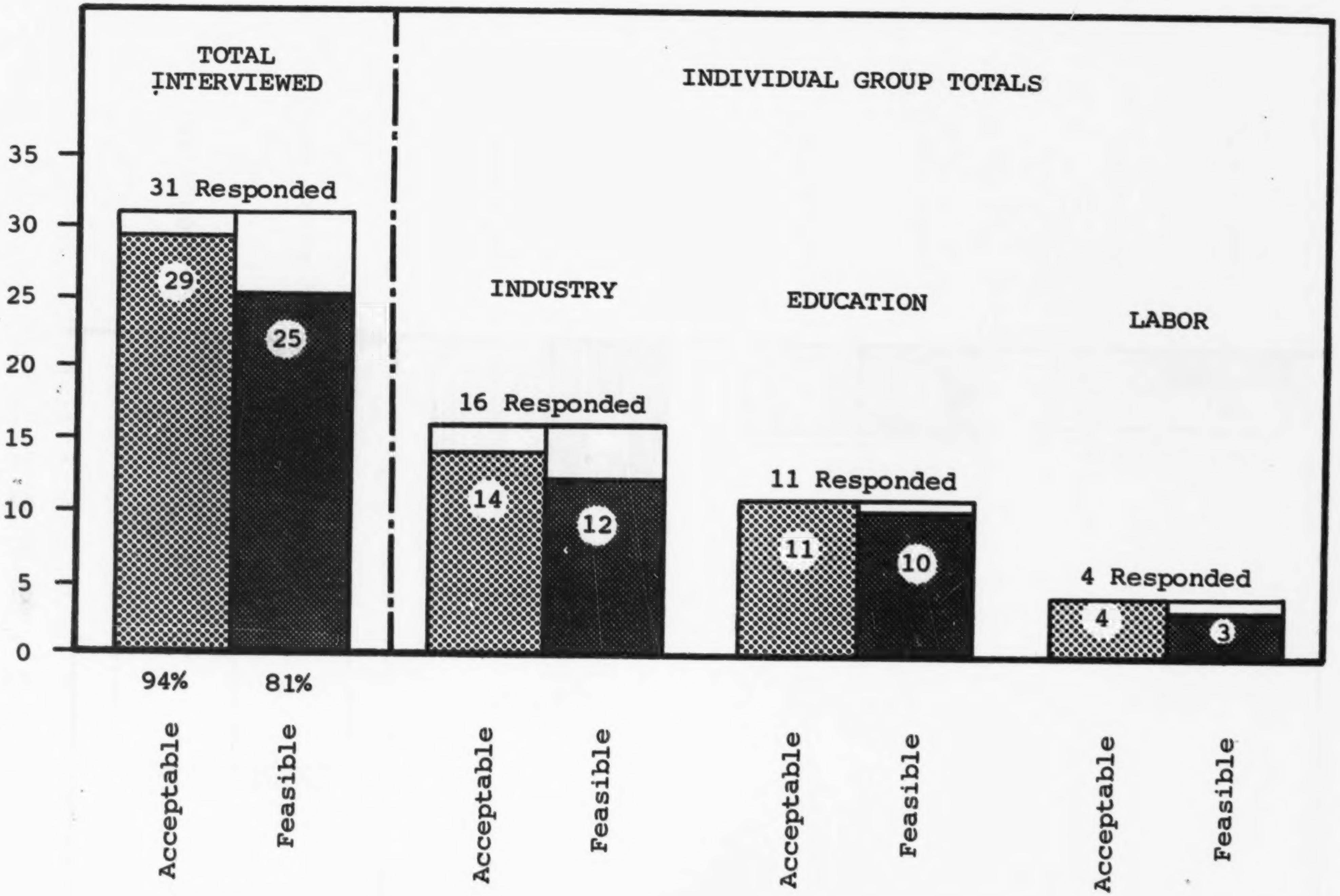

Figure 2. Acceptability and Feasibility Results

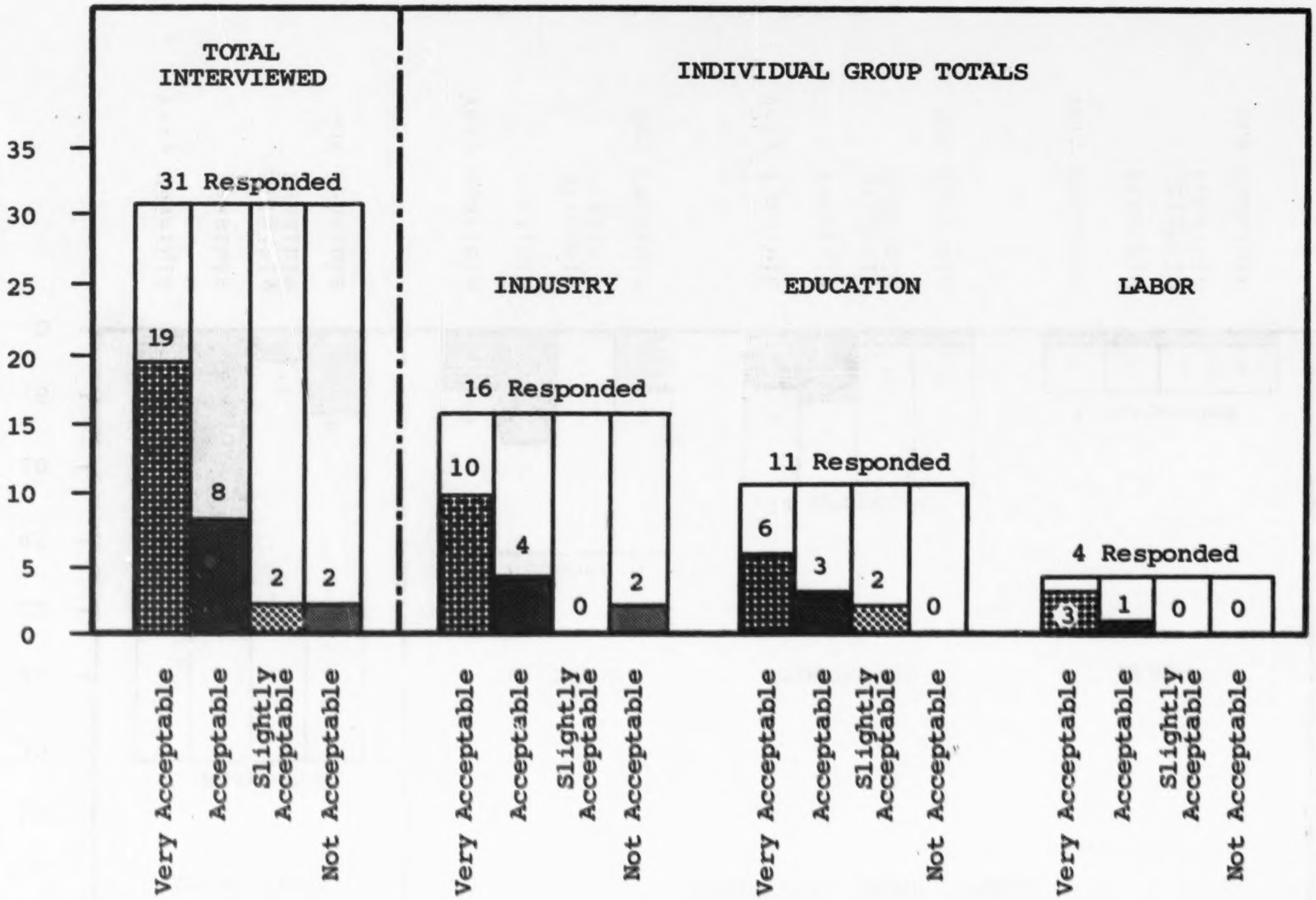

Figure 3. Acceptability Analysis

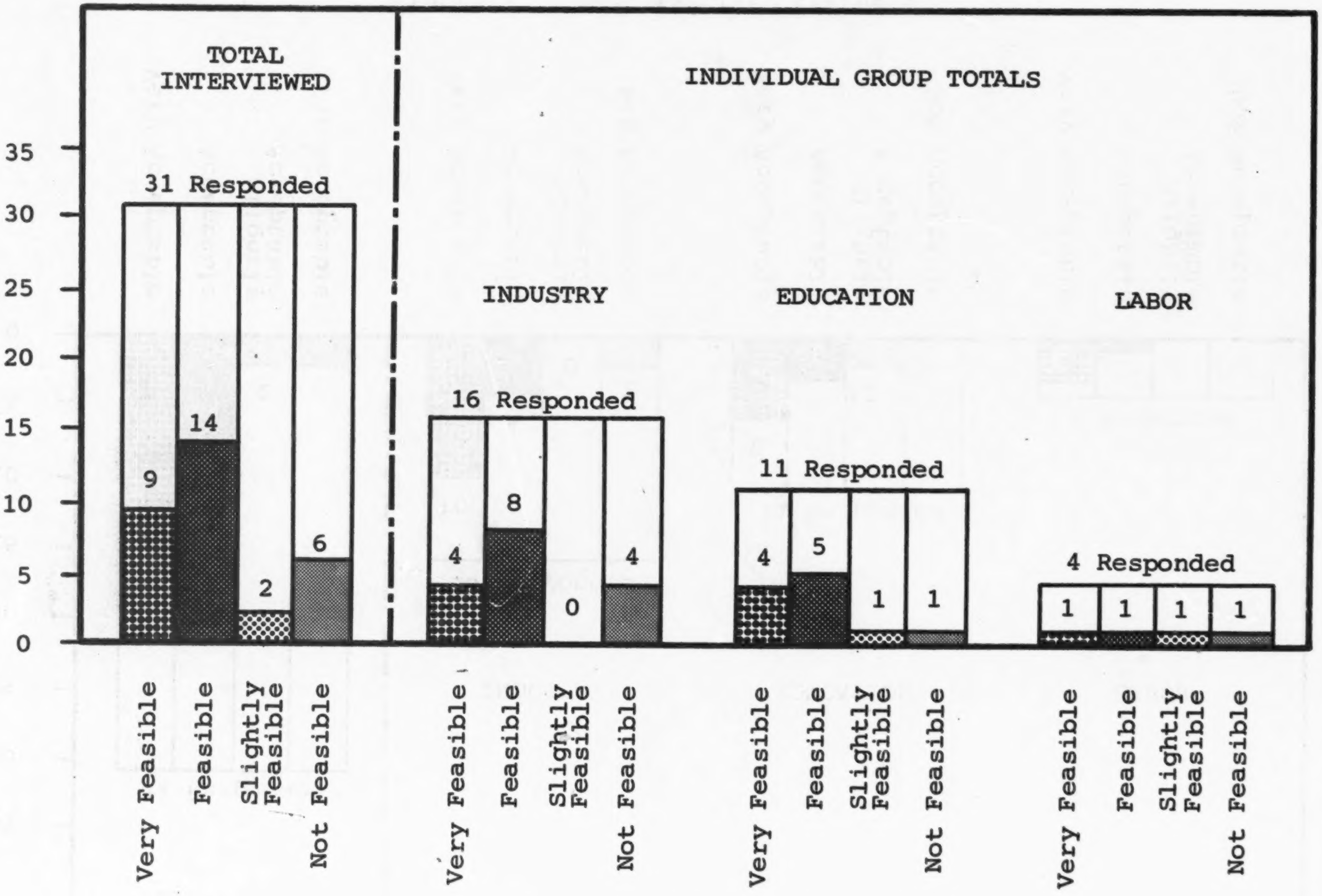

Figure 4. Feasibility Analysis

A desire for employees to obtain a "good attitude" toward their job appeared to be the most important concern of management. The opportunity for students to become acquainted with the requirements of several occupations was considered by management to play an important role in the formation of proper attitudes.

One individual, who expressed doubts concerning the acceptability of the program, represented a government ship yard. This person indicated that their employees must stay within a job classification, and the cluster concept program would not give the type of person they employ any advantage except to give him a better idea of the occupation he would like to enter. The other industrial representative, who expressed doubts concerning the acceptability of the program, felt that his firm needed people with a high degree of technical, specialized skill.

Seventy-five percent of those interviewed in industry indicated that the program was feasible. The following is a typical statement of those responding favorably in this area. "In the future, we will always be looking for this type of trainee---We will be glad to do anything we can to help the program. An individual with cluster concept training would very readily fit into our training program." The general reaction from this group was the fact that students with a cluster concept background could be readily employed and be able to advance in the company with on-the-job training or through a formal training program established by the industry. The utilities companies expressed a strong desire to have individuals with a cluster background in order to shift their men to different positions during the peak seasons of the year when gas (winter) and electricity (summer) would be in demand.

The four individuals who gave a negative reaction to the feasibility of the cluster concept felt that it would be impractical to implement because of rigid job specifications that were established by the unions in their plants.

All of the persons interviewed in education indicated that they were in favor of the cluster concept program. Six of the industrial education supervisors indicated that they had initiated a form of cluster program in their own county school systems. A strong desire to be kept informed of the project's progress was shown by such comments as, "I would be interested in a pilot program---we would be willing to try one, two, or three clusters."

Ten of the eleven individuals, concerned with the field of education, indicated that the cluster concept program was feasible and could be implemented in the secondary schools with little difficulty. One of the superintendents who had accepted the cluster concept felt he would have difficulty establishing the program due to a lack of trained staff members and facilities.

The educators greatest concern in the implementation of the cluster concept program was the availability of teachers capable of handling such a program. Everyone in the field of education who was interviewed raised this question with the interviewer. A typical comment that was made by a supervisor was: "The cluster concept program would not be feasible unless you get good instructors with a rich background of experience---The instructor is going to be the key to the success of this program."

A total of four representatives from labor were interviewed. All of the individuals interviewed in labor indicated their acceptance of the cluster concept program. One person's reaction indicated that the cluster concept was important for the future and the person with a cluster program background would be less difficult to train because of his flexibility. "A necessity for the future---such a program will give the student the opportunity to determine what his potentiality is in a given field and to select that occupation most commensurate with his ability and his liking."

The four individuals from labor who were interviewed indicated that the program was feasible with the exception of one person. This individual pointed out that it didn't require any specific background to enter the union but that the program would give a student an understanding of what to expect in an occupation.

Those individuals giving a favorable reaction to the feasibility of the cluster concept indicated the program would be valuable to the person entering the labor force. The training received in a cluster concept program would enable a student to select an apprenticeship program and be capable of performing some fundamental skills in the apprentice training.

H. Additional Sources of Information

There were various other sources of information pertaining to the acceptability and feasibility of the cluster concept approach. During the year several individuals representing education, government agencies, and industry associations were invited to weekly seminars held by the project team. One individual, who represented the apprenticeship program of the Department of Labor indicated that if an individual is trained in entry skills the more apt industry is to hire a person. The cluster concept program would also provide pre-apprentice training and a better background for selecting a specific occupational choice.

During a conference to determine job entry tasks, a representative from a large industrial union indicated that the cluster concept is the type of training that is being promoted for their workers in order to give them flexibility and versitility within a plant. The individuals representating the craft unions who participated in the conference indicated that the main value of a cluster concept program was the opportunity for students to explore a number of occupations before selecting specific training in one occupation.

The Principal Investigator and Project Coordinator presented the project to several civic groups, a county economic development commission, several educational groups, and a research conference. Many of the persons gave favorable comments after the presentations were completed.

A construction contractor indicated that he could use persons with the flexibility to work in different phases of home construction.

A vocational education teacher expressed a strong desire to develop other occupational clusters for implementation in the public school systems.

I. Reactions to the Cluster Concept Program

The following statements are examples of the comments that were made by individuals who reacted to the cluster concept approach for vocational education:

Director of Administration in a Chemical Company

> "I wish we had a dozen of them (individuals trained in a cluster concept) now---our employees must be able to move around and be retrainable."

Supervisor of Employment in a Gas Company

> "The cluster concept would very definitely fit into the training program of this company. We would have need of graduates from all clusters definitely. The cluster concept program would definitely fit people for employment in public utility companies. The flexibility of the preparation is in your favor because utility companies have peaks (gas service-winter, electric service-summer) and valleys. The company trains men to be flexible so they don't have to be laid off. The cluster program ties right in this teaching not just one skill but a smattering of knowledge of different skills."

Supervisor of Industrial Arts and Vocational Education in a County School System

> "I am very optimistic about the cluster concept and will be anxious to see something new coming along. Glad to see this study being conducted and we will be interested in participating in pilot programs."

"Kids now days don't know what they want to do in this very complex world. All kinds of forces work against them. It is very difficult for a boy in school today to choose his vocation and I think this cluster concept is very good in helping a boy find the areas he is interested in. It is very difficult for a ninth grader to make a choice."

"Another beautiful advantage of this cluster concept program is it would be set up in any comprehensive high school. You don't need a multi-million dollar facility to start this into operation. I mean, you could start tomorrow if you had the instructor. I stress the instructor, if you have to have a man who is a real leader and who really believes in this program. It is needed so badly in several of our high schools. We have numbers of youngsters who are floundering, they will work if given the opportunity. Very eager, but unhappy, they often become discipline problems because the academic principal does not know where to put them. We have no place for them. This is a place we can reclaim them in our educational program and get them going on their educational program. We would never feel guilty that we didn't help them if we had a program like this."

Superintendent of Schools in a County School System

"I am quite sold on the idea but I am practical to the extent that I can only do what I have room to do." It isn't only money, it's personnel that is involved here. If a teacher that could handle this type of program exists, I haven't seen one."

Director of Industrial Relations in an Aircraft Company

"I think a person trained in the cluster concept would be welcomed in industry more so than the kid who is just out of school without any real background like this."

Supervisor of Industrial Education with a County Board of Education

"I see real merit in this. We are thinking in terms of combining electricity/electronics with automotive mechanics. Ninth grader doesn't know what he wants. He may think he knows but many times he has changed by the time he is a senior.

It sounds good in terms of the worker being automated out or rather into another type job. I like the cluster concept because not all people are suited for one vocation. When trained in one vocation they are limited.

I sure would be interested in a pilot program. How much time will it take to initiate the program? We would be willing to try one, two or three (clusters). I believe we could handle the construction cluster very easily in terms of facilities."

President of a Union

"The cluster concept sounds like a very good program for the future, but it will not be a significant factor right now. It will probably be hard to convince those concerned that this program has something to offer. In general, the unions are aware that man must be flexible and mobile, and they probably will support the program."

Personnel Manager of a Vending Company

"A cluster program would be of value to an individual who has no previous vocational training and who knows he is not going to college to develop vocational skills, interests, or aptitudes. It would give an individual experiences to base his decision for vocational choice."

Head of an Industrial Training Program in a Manufacturing Company

"The company would never object to the cluster concept because this is the basis on which people have started. The unions have split the jobs up into so many functional, specific jobs that we cannot use this cluster concept in the actual working of it, but we would like to, I am sure."

Personnel Manager in a Manufacturing Company

"The program has merit. We would like to hire someone from a general type background. I think this won't replace traditional vocational programs but it is good for general students who don't have a salable skill to offer to industry. It would also help a student to decide what occupation he might desire to move into for his life work."

Director of Public Relations in a Manufacturing Company

> "This thing (cluster concept) would be very helpful to help a man get a job and keep a job. If a person knows a variety of things as a family they don't have the attitude of "that's not my job." I like this program and I would recommend it; it looks very worthwhile. I believe it is worthwhile for the man who is looking for a job."

Manager of Employment in a Defense and Space Center

> "Favorable - very good idea. This type of individual being looked for.
>
> A person with a cluster concept could possibly have one third the amount of time necessary in the present training program. Blueprint reading, shop math, and proper attitude are important for the program to develop in an individual."

J. Summary

The interview reports and review of literature provide an indication of the need, acceptability and feasibility of the cluster concept as a program in vocational education on the secondary level.

The available evidence obtained from the review of literature supports the premise that a cluster concept is needed in vocational education programs to provide students with occupational mobility, adaptability for technological change, and transferability of skills.

The interview results indicate that management is searching for workers with the ability to be flexible in performing a variety of jobs within a plant or industry. The primary concern of management was the type of attitude that an individual held with respect to his job and the organization where he worked.

Several individuals in management felt that the cluster concept approach to vocational education was worthwhile but would not be applicable in their particular industry or plant. These people indicated that union restrictions with respect to job classifications would prevent workers from moving back and forth across occupational lines.

The labor unions were divided in their reaction to a cluster concept program in vocational education. Several representatives from the craft unions indicated the main value of a cluster concept program was the opportunity for students to explore a number of occupations before selecting specific training in on occupation.

The representatives from industrial unions indicated that they desire individuals with a broad background in several occupational areas. This type of training would enable their members to obtain and hold jobs more readily because of the flexability built into their training.

The individuals interviewed in the field of education were enthusiastic in their reactions to the cluster concept approach. These people felt the program could provide those students pursuring a general course in high school with job entry skills in several occupational areas upon graduation from high school. The major concern of educators in the implementation of the cluster concept program was the availability of teachers capable of teaching the program.

The data collected from a review of literature, and interviews and discussions with representatives from industry, labor and education indicate that:

(1) There was a need and demand for training in clusters of families of occupations.

(2) The cluster concept was acceptable as a program in vocational education on the secondary school level.

(3) The cluster concept was feasible as a program in vocational education on the secondary school level.

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PART II REPORT

DEVELOPMENT OF OCCUPATIONAL CLUSTERS

A. Introduction

The second section of the three part final report is concerned with the development of occupational clusters and the selection of specific occupations within each cluster.

B. Research Procedures

The following procedures were utilized in developing the occupational clusters and the specific occupations in each cluster that would be suitable for a cluster concept program in vocational education at the secondary school level:

1. A review and evaluation of research in the area of occupational grouping was conducted to determine possible applications for the project.
2. A method of research, based upon a sampling technique proposed by Altman and Gagne of the American Institutes for Research, was developed to determine occupational clusters.[1]
    a. A list of criteria was prepared to use in selecting occupational clusters and specific occupations within the clusters.
    b. A group of possible occupational clusters was developed and several clusters were selected from the group for further analysis.

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[1] James W. Altman and Robert M. Gagne, First Interim Report on Research on Vocational Skills (Pittsburgh: American Institutes for Research, 1964).

c. A number of possible occupations were developed for each cluster and those occupations meeting the established criteria were selected for further analysis.

3. A group of three occupational clusters with their respective selected occupations was identified for further analysis.

C. Review of Occupational Classification Systems

A review of occupational classification systems was made for possible utilization in the selection and development of "clusters" of occupations. The two most common classification systems used in the United States are the Dictionary of Occupational Titles (DOT)[2] produced by the Bureau of Employment Security of the U. S. Department of Labor and the Classified Index of Occupations and Industries[3] produced by the Bureau of Census of the U. S. Department of Commerce.

The Bureau of Census classification system was based on a survey which sampled the entire labor force. The information obtained from the survey was coded and tabulated in an Alphabetical Index of Occupations and Industries[4] and a Classified

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[2] U. S. Department of Labor, Bureau of Employment Security, Dictionary of Occupational Titles, Vol. I and II, Third Edition (Washington: Government Printing Office, 1965).

[3] U. S. Department of Commerce, Bureau of Census, 1960 Census of Population Classified Index of Occupations and Industries (Washington: Government Printing Office, 1960).

[4] U. S. Department of Commerce, Bureau of Census, 1960 Census of Population Index of Occupations and Industries (Washington: Government Printing Office, 1960).

Index of Occupations and Industries.[5] The Alphabetical Index lists each occupation in alphabetical order and provides two three digit numbers to identify the occupational and industrial classification code.

The Classified Index classified occupational titles into two hundred and sixty-nine occupational categories by using a three digit code. An occupational category consisted of a homogeneous group of occupations and defined a particular field of work. The occupations were also classified into one hundred and forty-six industry categories with a three digit code. An industry category consisted of a homogeneous group of industry titles and defined a particular industrial field.

A classification system which was developed for world wide application is the International Standard Classification of Occupations.[6] This classification system was developed by the International Labor Office (ILO) in Geneva, Switzerland and was intended to facilitate the international exchange of occupational information. The system was based on ten major groupings similar to the Bureau of Census classification system and does not require replacement of existing classification structures.

After reviewing the Classified Index of Occupations and Industries and the International Standard Classification of Occupations, it was concluded that these classifications would not be applicable in determining occupational clusters for vocational education. The three digit categories of the Bureau of Census classification system were too narrowly defined for including several occupational areas within one group. (For example, 421 Electricians, included specialized occupations for electricians.)

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[5] U. S. Department of Commerce, loc. cit.

[6] International Labor Office, International Standard Classification of Occupations, Report II (Geneva: International Labor Office, 1957).

The military services have developed occupational classification systems for their enlisted personnel. One type of military classification system was the Manual of Enlisted Military Occupational Specialities (MOS) published by the Department of the Army.[7] The term MOS was used to identify groupings of military jobs possessing such close relationship that an optimal degree of interchangeability exists among qualified persons.

A great deal of similarity existed between the Army classification system and other military occupational classification systems. The Air Force specialities were grouped under forty-three career fields with over two hundred and forty specialities.[8] The Marine Corps had thirty-seven occupational fields which were subdivided into billets and further subdivided into tasks.[9] The

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[7] Department of the Army, Manual of Enlisted Military Occupational Specialities, (C15, AR 611-201) (Washington: Government Printing Office, 1965).

[8] Department of the Air Force. Occupational Handbook for Airmen, (CA 66-3-69M) 1966-1967 Edition (Washington: Government Printing Office, 1966).

[9] Department of the Navy, United States Marine Corps. A Guide to Occupational Specialties and Schools (Washington: Government Printing Office, 1965).

U. S. Navy Occupational Handbook had seventy-two career briefs under twelve major occupational groups.[10] These major occupational groups were subdivided into sixty-two subgroups or job fields.

Although the four military classifications were quite comrehensive, they were not appropriate for use in developing occupational clusters because the occupations classified were primarily military in nature.

A review was made of the third edition of the Dictionary of Occupational Titles for possible use of existing occupational groupings developed from observation and analysis of jobs over the last twenty-five years. The DOT classified 21,741 occupations using a six digit code to identify each occupation.[11]

The six-digit code of the DOT was divided into two parts: (1) The Occupational Group Arrangement which was represented by the first three digits and (2) the Worker Traits Arrangement represented by the last three digits. "These provided (1) a method of grouping jobs having the same basic occupational or worker trait characteristics so that the user can discern various relationships among occupations, and (2) a standard approach to classifying the abilities, vocational experiences, and/or potentials of workers."[12]

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[10] Department of the Navy, Bureau of Naval Personnel. United States Navy Occupational Handbook, (NRAF 41548) Fourth Edition (Washington: Government Printing Office, 1963).

[11] U. S. Department of Labor, op. cit., p. xv, Volume I.

[12] Ibid., pp. xvi-xvii.

The Occupational Group Arrangement (represented by the first three digits) had the jobs grouped according to work field, purpose, material, product, subject matter, service, generic term, and/or industry or a combination of the above. The first digit represented the nine occupational categories. The second digit in conjunction with the first digit represented the eighty-four divisions of occupational categories, and the third digit along with the first two digits represented the 603 groups which are subdivisions of the two-digit divisions.

Under the Worker Traits Arrangement of the DOT (represented by the last three digits) the worker functions were related to Data, People, and Things which were represented by the fourth, fifth, and sixth digits, respectively. A hierarchy from the simple (8) to the complex (0) was established for each of the three worker functions. The last three digits expressed the total level of complexity at which the worker functions. This arrangement of the DOT was divided into twenty-two broad areas of work which was subdivided into 114 worker trait groups. An examination of the DOT indicated that the two digit divisions established on the basis of work fields, materials, and products would be most feasible as occupational families for the development of cluster concept programs.

A further examination of the divisions and the three digit classifications within the divisions revealed occupational groupings that were too narrowly defined for inclusion of a wide range of occupations for a cluster concept program. (Division 81 Welders, Flame Cutters, and Related Occupations is an example of what was considered a narrow category for a cluster concept program). Other occupations that were related on the basis of work fields were found in separate divisions (Division 65 Printing Occupations and Division 97 Occupations in Graphic Arts).

After examining and evaluating the DOT, the conclusion was reached that the divisions, with the possible exception of Construction, were not suitable for the purpose of developing curriculum for a cluster concept program in vocational education.

D. Identification of Occupational Clusters

A study, conducted by Altman and Gagne for the purpose of developing test items for measuring general vocational skills, was reviewed for a possible solution to the problem of developing occupational clusters. Altman and Gagne made the following statement with respect to the use of the DOT and the problem of developing occupational families:

> Given, then, that there is no known method for easily and directly deriving general skills and knowledges from information in the new DOT, some substantial effort is suggested which will study each job or family of closely related jobs. Unless one can mount a really monumental effort, the implication is that the derivation of general skills and knowledges will have to be based on a sampling of jobs.[13]

Since the project was limited in terms of time and financial support, it was considered necessary to provide a rational frame of reference to guide the process of identifying occupational clusters and the selection of specific occupations within the cluster. It became apparent that the establishment of criteria for selecting a cluster and a sample of occupations in the cluster was the only realistic approach that could be utilized in the project. The ultimate test of this approach would be the completed analysis identifying the commonalities within the occupational cluster.

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[13] Altman and Gagne, op. cit., p. 7.

A list of criteria for selecting occupational clusters was established through a series of discussions among the project team as well as consultation with members of the Industrial Education Department. The following criteria were established for the purpose of identifying occupational clusters for a cluster concept program in vocational education:

The occupational cluster should:

1. Be in the area of vocational industrial education.
2. Include occupations that are related on the basis of similar processes, materials, and products.
3. Be broad enough to include occupations with a wide variety of skills and knowledge.
4. Involve occupations that require not more than a high school education and/or two years beyond high school.
5. Provides the opportunity for mobility on a geographical and occupational basis.

After establishing the criteria for selecting occupational clusters, a group of possible clusters were developed from consultations and discussions with Mr. A. B. Eckerson, Chief of Occupational Dictionary & Classification Section, Bureau of Employment Security, U. S. Department of Labor and officers in charge of Army Occupational Classification Systems in the Pentagon. The list of suggested cluster titles was also obtained from seminar discussions and titles found in sources such as the Occupational Outlook Handbook[14] and the Dictionary of Occupational Titles.[15]

The following is the original list of suggested cluster titles that was given consideration by the project team:

Medical and Health
Home Facilities
Heavy Construction
Light Construction
Machining
Electricity and Electronics
Communications
Transportation
Food Processing
Office Occupations
Mechanical and Fabrication
Repair Service and Maintenance
Personal Services

The list was not considered to be a complete listing of all the possible occupational clusters. It was the starting point in the task of identifying occupational clusters for a cluster concept program in vocational education. After examining and evaluating the list of possible clusters, a decision was made to limit the number of clusters to be included in the project. A limitation of three occupational clusters was made and this conclusion was based upon the following factors:

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[14] U. S. Department of Labor, Bureau of Labor Statistics. Occupational Outlook Handbook, 1966-67 Edition (Washington: Government Printing Office, 1966).

[15] U. S. Department of Labor, loc. cit.

1. The time allotted for the completion of the project.
2. The number of personnel available to work on the project.
3. The experiences and educational background of the project team members.

The following occupational clusters were tentatively identified within the limitations and the established criteria:

Construction
Electricity and Electronics
Repair Service and Maintenance
Mechanical and Fabrication

When attempting to identify occupations within clusters, it became evident that each cluster title needed to be clearly stated and carefully defined. Restating and defining the titles caused rearrangements and deletions which reshaped the clusters. For example, the title "Mechanical and Fabrication" was considered to be too general and was more clearly delimited when changed to "Metal Forming and Fabrication".

The original "Electricity and Electronics" cluster as a title was eliminated, but the cluster was combined with the "Repair Service & Maintenance" cluster to form a new cluster entitled "Electro-Mechanical Installation & Repair". The combination of these two original clusters was necessary for two reasons: (1) to stay within the limitations of the number of clusters, and (2) these two clusters had common elements with electrical and mechanical installation and repair.

The "Construction" cluster title was considered appropriate since it involved occupations that are related on the basis of similar industrial processes. The reshaped and more carefully defined clusters were then applied to the previously mentioned criteria for selecting clusters. The following three clusters were identified for further investigation in the study:

(1) CONSTRUCTION - those occupations dealing with the building of homes.

(2) METAL FORMING AND FABRICATION - those occupations dealing with machining, forming, bending, and joining of metals.

(3) ELECTRO-MECHANICAL INSTALLATION AND REPAIR - those occupations dealing with the installation and repair of electrical and mechanical equipment found in homes and business offices.

E. Selection of Occupations Within the Clusters

After the selection and definiation of the occupational clusters had been accomplished, appropriate occupations needed to be identified for each cluster. The following criteria were established for the purpose of identifying specific occupations within the clusters:

1. A favorable employment outlook.

   The occupations selected for the cluster should be those occupations which are expected to increase through 1975 as reported by the Occupational Outlook Handbook and involve large numbers of individuals in the occupation.

   Example: Machinist (included--thousands of job openings) vs. electroplaters (not included-few hundred job openings).

2. The instructional capability of being implemented in a secondary school program.

   The occupations selected for the cluster should be capable of being taught to high school students in a laboratory environment with tools and equipment that are needed in the occupation.

Example: Carpenter (included--physically capable of being taught in a laboratory) vs. excavators (not included--physically incapable of being taught in a laboratory).

3. Opportunity for job entry upon graduation from high school.

   The occupations selected for the cluster should enable a high school graduate to enter into the occupation without extended period of employment in a prerequisite occupation.

   Example: Machinist (included--high school graduate may enter) vs. layout man (not included--requires experience as a machinist).

4. Numerous skills and knowledge providing an opportunity for the identification of commonalities with other occupations.

   The occupations selected should involve various skills and knowledge in order to perform the work involved in the occupation.

   Example: Mason (included--involves use of many skills and knowledge) vs. hod carriers (not included--requires little skill or knowledge).

5. Opportunity for advancement through further schooling, apprentice programs, or on-the-job training.

   The occupations selected should provide an individual with the opportunity to obtain in-depth specialized training through technical schools, correspondence courses, apprentice programs, or on-the-job training.

   Example: Electrician (included--apprenticeship program available) vs. construction laborer (not included--no further training necessary).

A list of occupations which best fit the definition of each cluster was compiled from the Dictionary of Occupational Titles and the Occupational Outlook Handbook. The occupations were then examined with respect to the first criteria which was considered to be the most important in the selection process. Those occupations having a favorable employment outlook were then examined with respect to the second, third, fourth, and fifth criteria until a group of occupations were identified that produced the "best fit" with the established criteria. Figures 5, 6 and 7 illustrate the possible occupations which were considered for the identified clusters and each table provides an indication of those occupations which best fit the established criteria for each cluster.

The following literature was used in selecting the occupations for each cluster:

1. The 1966-67 edition of the Occupational Outlook Handbook[16] was used as a reference to evaluate the employment outlook for each of the listed occupations. This source gave information concerning the present and future opportunities due to replacements and expected growth for each occupation.

2. The 1965 edition of The National Apprenticeship Program,[17] a booklet published by the Bureau of Apprenticeship and Training of the U. S. Department of Labor, was reviewed to determine what occupations had apprenticeship programs. Included in this booklet was a list of apprenticeable occupations registered with State Apprenticeship Agencies and those registered with the Bureau of Apprenticeship and Training.

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[16] Ibid.

[17] U. S. Department of Labor, Bureau of Apprenticeship and Training. The National Apprenticeship Program, 1965 Edition (Washington: Government Printing Office, 1965).

METAL FORMING AND FABRICATION

Those occupations dealing with machining, bending, and joining of metals.

Occupations	Evaluative Criteria				
	1	2	3	4	5
Assembler	+	+	+	+	+
Boilermaker	0				
Instrument Maker.	0				
Iron Worker	+	0			
Jewelry Maker	0				
Machinist	+	+	+	+	+
Metal Spinner	0				
Riveter	0				
Sheet Metal Worker	+	+	+	+	+
Tool & Die Maker.	+	0			
Welder	+	+	+	+	+

Note:

An occupation meeting a criterion was assigned a "+". If an occupation did not meet a criterion, it was assigned a "0" and received no further consideration.

Figure 5. Occupational Selection

ELECTRO - MECHANICAL INSTALLATION & REPAIR

Those occupations dealing with installation and repair of electrical and mechanical equipment found in homes and business offices.

Occupations	Evaluative Criteria				
	1	2	3	4	5
Airconditioning & Refrigeration Mechanic	+	+	+	+	+
Appliance Serviceman	+	+	+	+	+
Automatic Bowling Machine Mechanic	0				
Automobile Mechnaic	+	+	+	+	+
Business Machine Serviceman	+	+	+	+	+
Instrument Repairman	+	+	0		
Maintenance Electrician	+	+	+	+	+
Millwright	0				
Television & Radio Service Technicain	+	+	+	+	+
Vending Machine Mechanic	0				
Watch Repairman	0				
Central Office Craftsman	0				
Lineman & Cable Splicer	0				
Telephone & PBX Installer & Repairman	0				
Transmission & Distribution Occupations	0				
Customer Service Occupations	0				

Figure 6. Occupational Selection

CONSTRUCTION

Those occupations dealing with the building of homes.

Occupations	Evaluative Criteria				
	1	2	3	4	5
Asbestos & Insulation Installer	0				
Bricklayer.	+	+	+	+	+
Carpenter	+	+	+	+	+
Cement Mason	+	+	+	+	+
Construction Laborer	+	+	+	0	
Electrician	+	+	+	+	+
Elevator Constructor	0				
Floor Covering Installer	0				
Glazier	0				
Lather.	0				
Marble, Tile, Terazzo Installer	0				
Operating Engineer.	+	0			
Painter & Paperhanger	+	+	+	+	+
Plasterer	0				
Plumber & Pipefitter	+	+	+	+	+
Roofer.	0				
Stone Mason	0				
Structural - Reinforcing Iron Worker	+	0			

Figure 7. Occupational Selection

3. The Employment and Earnings Statistics for the United States 1909 - 1964,[18] issued December 1964, and the Employment and Earnings Monthly Report[19] are publications edited by the United States Department of Labor's Bureau of Labor Statistics. These publications list employment, hours and earnings, labor turnover, and other specail tables for each industry. This information was of value when considering trends, patterns, and future outlook for the individual occupations.

4. The U. S. Industrial Outlook 1966,[20] a publication of the United States Department of Commerce, provided an industrial outlook for each industry in both narrative and table form showing growth and trends in the terms of dollars and percent change from 1958 to 1966. Recent trends and patterns were obtained from this publication.

After examining the complete listing of occupations in the clusters with respect to the established criteria and review of literature, a group of occupations were selected for each cluster as shown in Figure 8.

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[18] U. S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings Statistics for the United States 1909-1964 (no. 1312-2) (Washington: Government Printing Office, 1964).

[19] U. S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings and Monthly Report on the Labor Force, Vol. 12, No. 11 (Washington: Government Printing Office, May 1966).

[20] U. S. Department of Commerce, Business and Defense Services Administration. U. S. Industrial Outlook 1966 Industry by Industry (Washington: Government Printing Office, 1965).

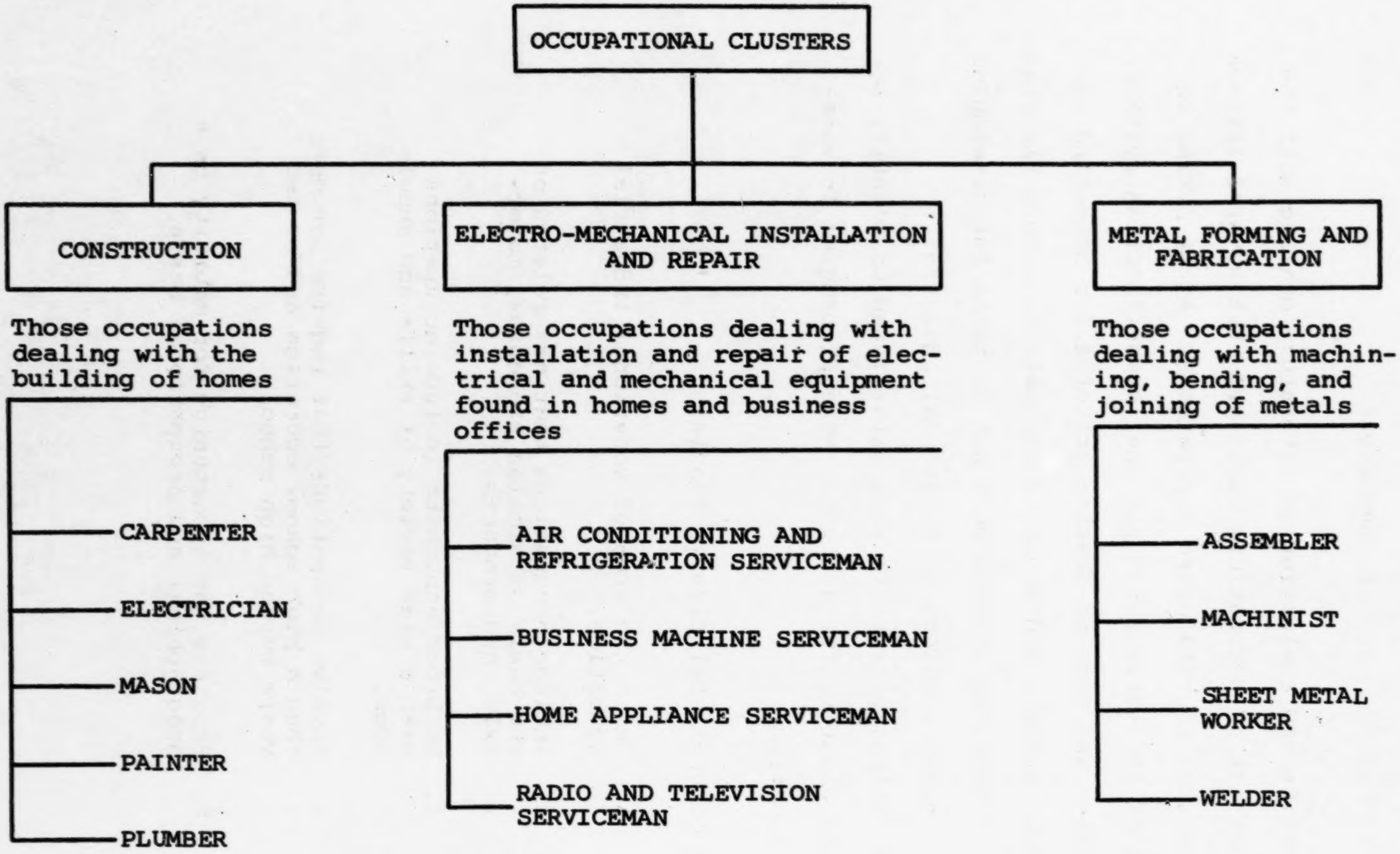
OCCUPATIONAL CLUSTERS
CONSTRUCTION
Those occupations dealing with the building of homes
CARPENTER
ELECTRICIAN
MASON
PAINTER
PLUMBER
ELECTRO-MECHANICAL INSTALLATION AND REPAIR
Those occupations dealing with installation and repair of electrical and mechanical equipment found in homes and business offices
AIR CONDITIONING AND REFRIGERATION SERVICEMAN
BUSINESS MACHINE SERVICEMAN
HOME APPLIANCE SERVICEMAN
RADIO AND TELEVISION SERVICEMAN
METAL FORMING AND FABRICATION
Those occupations dealing with machining, bending, and joining of metals
ASSEMBLER
MACHINIST
SHEET METAL WORKER
WELDER

Figure 8. Occupational Clusters

F. Summary

A review and evaluation of literature dealing with the classification of occupations indicated that several systems have been used to catagorize occupations. After making an analysis of the various occupational classification systems, the decision was made to develop criteria for selecting occupational clusters and specific occupations within the clusters since existing systems were not suitable for developing cluster concept programs in vocational education.

The following criteria were established to identify occupational clusters for a cluster concept program in vocational education.

The occupational cluster should:

1. Be in the area of vocational industrial education.
2. Include occupations that are related on the basis of similar processes, materials, and products.
3. Be broad enough to include occupations with a wide variety of skills and knowledge.
4. Involve occupations that require not more than a high school education and/or two years beyond high school.
5. Provides the opportunity for mobility on a geographical and occupational basis.

The following occupational clusters were established through the application of the established criteria and limitations of the project:

(1) CONSTRUCTION - those occupations dealing with the building of homes.

(2) METAL FORMING AND FABRICATION - those occupations dealing with machining, forming, bending, and joining of metals.

(3) ELECTRO-MECHANICAL INSTALLATION AND REPAIR - those occupations dealing with the installation and repair of electrical and mechanical equipment found in homes and business offices.

The following criteria were established for selecting special occupations in the clusters for a cluster concept program in vocational education:

The occupation selected must have:

1. A favorable employment outlook.
2. The instructional capability of being implemented in a secondary school program.
3. Opportunity for job entry upon graduation from high school.
4. Numerous skills and knowledge providing an opportunity for the identification of commonalities with other occupations.
5. Opportunities for advancement through further schooling, on-the-job training, or apprentice programs.

As a result of examining a list of possible occupations for each cluster with respect to the established criteria, three occupational clusters with their specific occupations were identified as shown in Figure 8.

G. References

Altman, James W. and Gagne, Robert M. *First Interim Report on Research on Vocational Skills*. Pittsburgh: American Institutes for Research, 1964.

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U. S. Department of Commerce, Bureau of Census. *1960 Census of Population Index of Occupations and Industries*. Washington: Government Printing Office, 1960.

U. S. Department of Labor, Bureau of Employment Security. *Dictionary of Occupational Titles*, Vol. I. Third Edition. Washington: Government Printing Office, 1965.

U. S. Department of Labor, Bureau of Labor Statistics. *Occupational Outlook Handbook*. 1966-67 Edition. Washington: Government Printing Office, 1966.

U. S. Department of Labor, Bureau of Apprenticeship and Training. *The National Apprenticeship Program*. 1965 Edition. Washington: Government Printing Office, 1965.

U. S. Department of Labor, Bureau of Labor Statistics. *Employment and Earnings Statistics United States 1909-1964*, (No. 1312-2). Washington: Government Printing Office, 1964.

U. S. Department of Labor, Bureau of Labor Statistics. Employment and Earnings and Monthly Report on the Labor Force, Vol. 12, No. 11. Washington: Government Printing Office, May 1966.

U. S. Department of Commerce, Business and Defense Services Administration. U. S. Industrial Outlook 1966 Industry by Industry. Washington: Government Printing Office, 1965.

PART III. DEVELOPMENT OF COURSE OUTLINES

A. Introduction

The third and final section of this three part report is concerned with the development of the course outlines for the occupational clusters of construction, metal forming and fabrication, and electro-mechanical installation and repair. This section will address itself to the procedures and techniques used in developing the course outlines for use in a cluster concept program in vocational education at the secondary school level.

B. Research Procedures

The following procedures were utilized in the development of course outlines for a cluster concept program:

1. A review of research was conducted to determine methods of analyzing the selected occupations in order to identify the common areas of human requirement needed for each occupational family.
2. A method based upon a procedure proposed by Smith of the Human Resources Research Office, was developed to analyze each occupation in the cluster.[1]
    a. A list of tasks was developed for each occupation through a review of train-

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[1] Robert G. Smith, Jr., *The Development of Training Objectives*, Research Bulletin No. 11 (Alexandria, Virginia: Human Resources Research Office, 1964).

ing manuals, courses of study, textbooks, and interviews with representatives from each occupation.

   b. A task identification inventory was developed and submitted to a group of individuals representing the selected occupations in order to determine job entry tasks.

   c. The identified job entry tasks were analyzed to determine the areas of human requirement (skills, mathematics, measurement, science, communication, and information) needed to successfully perform the task.

3. An analysis technique, based on a study by Miller and Folley, was used to identify the common areas of human requirement within each occupational cluster.[2]

   a. The areas of human requirement were examined to determine the commonalities that existed among the occupations within the cluster.

   b. Judgements were made by project personnel to select the common areas of human requirement needed for performing the occupations within the occupational clusters.

4. A course outline for each occupational family was developed from the identified common areas of human requirement.

C. Methods of Analyzing Occupations To Determine Commonalities

A review of the literature was conducted to determine methods of analyzing the selected occupations for the purpose of identifying common areas of human requirement (math, science, measurement, communication, skills, and information) needed for successful job entry performance in the selected occupations. The review of literature was made for the purpose of identifying techniques that could be utilized in accomplishing the purposes of the project.

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[2] Robert B. Miller, John D. Folley, Jr., and Phillip R. Smith, A Comparison of Job Requirements for Line Maintenance of Two Sets of Electronic Equipment, (AFPTRC-TR-54-83) (Lackland AFB, Texas: Air Force Personnel and Training Research Center, December, 1954).

Palmer and McCormick, in a study to identify worker activities, expressed two points of view in approaching the domain of human work. One point of view, called the Job Oriented, emphasized the technological aspects of jobs and the accomplishments of workers such as painting, selling, or baking. The Worker Oriented emphasized what workers do in performing their jobs. In general, the difference between the two viewpoints was that the "job oriented" view is likely to place emphasis on conditions and results of work, while the "worker oriented" view tends to place emphasis on worker activities.[3] The study performed by Palmer and McCormick emphasized the "worker oriented" viewpoint in the identification of job dimensions. A check list of job activities was submitted and the results were subjected to a factor analysis. Five major factors and fourteen multiple group factors emerged as a result of the study. The five major factors were: I. Information - receiving activities, II. Mental activities, III. Supervisory and communication activities, IV. Manual activities and V. General bodily activities.[4]

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[3] George J. Palmer, and Ernest J. McCormick, "A Factor Analysis of Job Activities," Journal of Applied Psychology 45: 284-289 (August, 1961).

[4] Ibid.

Several studies utilizing factor analysis techniques were reviewed for a possible solution to the problem of identifying common areas of human requirement. A report by Coombs described a factor analysis approach to the identification of job families. An analysis of seventy jobs in a paper mill was made using methods developed by the U. S. Employment Service. Correlations were obtained from ratings of the job descriptions of fifty-four occupations. Several factors were identified that included: self responsible jobs, routine entry jobs, skilled machine operation jobs, and clerical jobs.[5]

A study was made by Johnson to determine functional job interrelationships in the motor vehicle maintenance field. A check list of activities and objects maintained on motor vehicles was developed and submitted to workers engaged in repairing motor vehicles. The results of the research indicated that the check list technique can reveal factors operating in a number of different jobs. The factor score patterns could provide a rough but easily applied means by which jobs can be compared and training needs identified.[6]

The factor analysis studies that were reviewed indicated that it was possible to identify commonalities among a group of selected occupations. A decision was made, however, to investigate other techniques of identifying commonalities since the goal of the project was to develop suggested course outlines identifying commonalities in a cluster of occupations rather than explaining the commonalities in terms of a minimum number of hypothetical factors.

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[5] C. H. Coombs and G. A. Satter, "A Factorial Approach to Job Families," Psychometrika, 14:33-42, 1949.

[6] Duance Morton Johnson, "A Study of Responses to a Work Activities Check List to Determine Functional Job Inter-Relationships" (unpublished Ph. D. dissertation, Purdue University, West Lafayette, Indiana, 1957).

A hierarchial clustering technique developed by Christal and Ward was reviewed for possible use in identifying commonalities among the occupational clusters. The technique utilizes a computer program that forms mutually exclusive clusters by systematically reducing the number of groups for N to N-2, and so on down to one group, in a manner that minimizes the loss of information or the error resulting form the grouping.[7]

A decision was made not to use this technique since Christal and Ward stated that it was only practical to apply this technique to large scale studies with the use of a high speed computer.

A research bulletin entitled The Development of Training Objectives written by Robert G. Smith, Jr., of the Human Resources Research Office, was found applicable to the problem of analyzing the identified occupations in the cluster.[8] A modified procedure, based on Smith's approach, was developed to determine the areas of human requirement needed for successful performance in the occupations. An analysis technique, based on a study by Miller and Folley, was found applicable to the problem of identifying the commonalities that exist among the areas of human requirement in each occupational cluster. A schematic of the research procedure is shown in Figure 9.

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[7] Raymond E. Christal and Joe H. Ward, Jr., "Applications of a New Clustering Technique Which Minimizes Loss in Terms of Any Criterion Specified," (Lackland AFB, Texas: 6570th Personnel Research Laboratory).

[8] Smith, loc. cit.

D. Development of Task Statements

The initial step involved the development of a task inventory for each occupation through a review of job descriptions, textbooks, courses of study, training manuals, and interviews with individuals representing the selected occupations. Each task was written in behavorial terms which described some aspect of the behavior required for performance of the occupation.

In order to prepare the task statements in behavorial terms, a review of literature was iniatated to determine the most appropriate format to be used in writing the statements.

A task according to the U. S. Employment Service is:

> one of the distinct major activities that constitutes logical and necessary steps in the work performed by the worker. It is the work unit that deals with the methods, procedures, and techniques (the "what", "how", and "why") by which parts of a job are carried out. A task or duty is created whenever human effort, in terms of one or more elements, must be exerted for a specific purpose.

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[9] Bureau of Employment Security, Training and Reference Manual for Job Analysis (Washington: Government Printing Office, 1965), p. 6

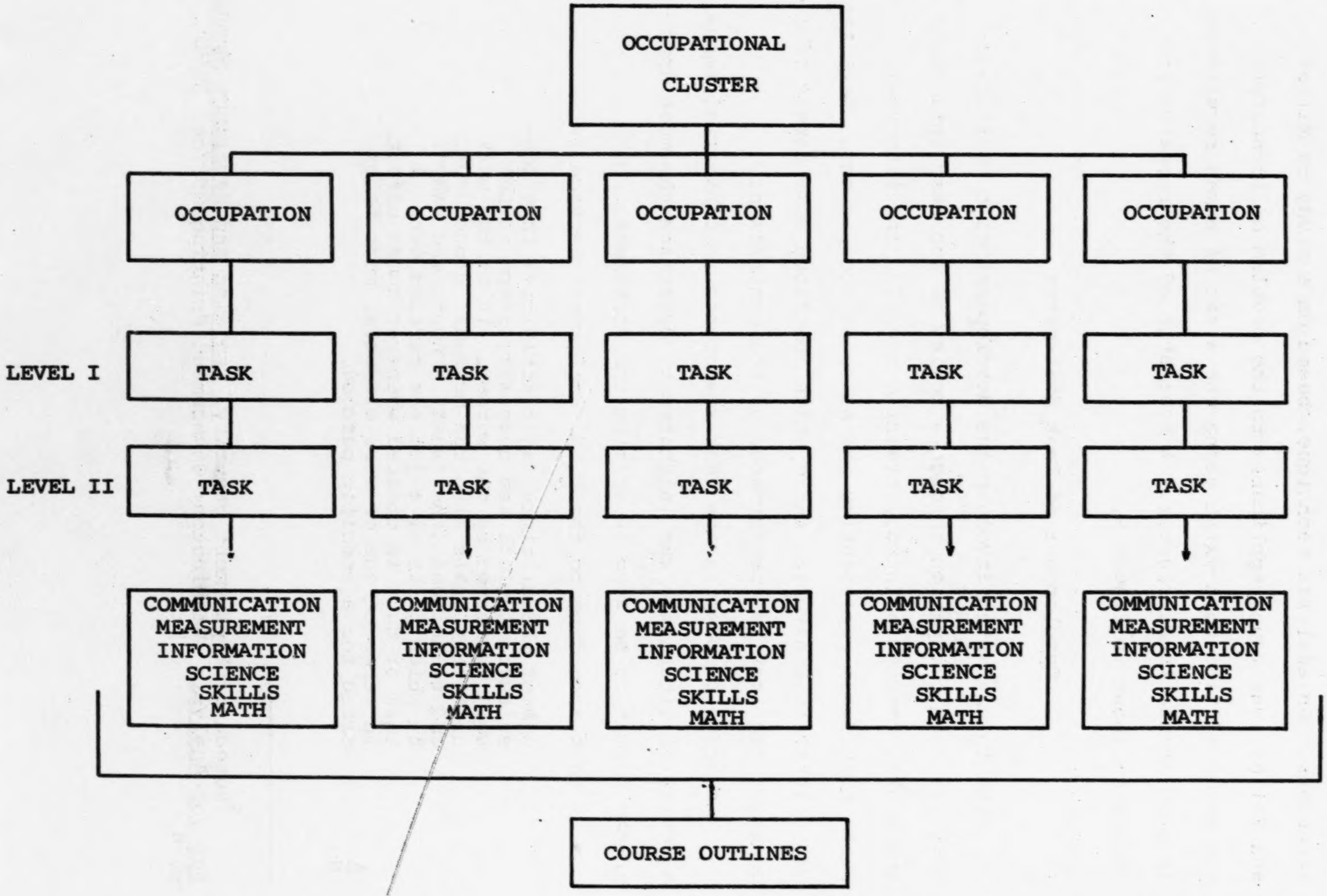
OCCUPATIONAL CLUSTER
OCCUPATION
OCCUPATION
OCCUPATION
OCCUPATION
OCCUPATION
LEVEL I
TASK
TASK
TASK
TASK
TASK
LEVEL II
TASK
TASK
TASK
TASK
TASK
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COMMUNICATION MEASUREMENT INFORMATION SCIENCE SKILLS MATH
COURSE OUTLINES

Figure 9. Research Model For Developing Course Outlines

Gagne and Fleishman stated that "tasks are statements which taken all together, constitute the job."[10] A job is defined as "each individual set of human activities to be performed by one person in a particular plant."[11]

The Bureau of Naval Personnel defined a task as a "group of closely related work elements which constitutes an integral step in the performance of a duty. For example: test refrigeration plant for leaks using torch type leak detector."[12]

The Air Force defined a task as a "unit of work activity which forms a consistent and significant part of a duty."[13]

A similar definition of a task was proposed by the Army. "A 'task' is one of the work operations that constitutes a logical and necessary step in the performance of a duty."[14]

Smith discussed tasks as being a necessary part of the performance of a duty. A duty is defined as: "one of the several distinct major activities comprising a job...each job being made up of one or more duties."[15] A task is defined as:

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[10] Robert M. Gagne and Edwin A. Fleishman, Psychology and Human Performance (New York: Henry Holt and Company, 1959), p. 343.

[11] Ibid.

[12] Bureau of Naval Personnel, Handbook for Naval Occupational Analysis, NAVPERS 15803-A (Washington: Bureau of Naval Personnel, November, 1961), p. 4.

[13] Department of the Air Force, Occupational Analysis, AF Manual 35-2 (Washington: Department of the Air Force, 1961). p. 5.

[14] The Adjutant General's Office, Army Job Analysis Manual I, SDB Report No. 1-60-OR (Washington: Department of the Army, 1960) p. 6.

> "A group of activities that generally occur close together and have a common purpose; it forms a logical and necessary part of the performance of a duty.
>
> For example, the job of an auto mechanic is composed of such duties as tuning up the motor, grinding the valves, and so forth. The duty of tuning the motor includes such tasks as adjusting the carburetor and removing, cleaning, adjusting, or replacing spark plugs.
>
> Task inventories are useful in two ways: first...they assist in collecting data on the performance of tasks in the field or on the job, for use in deciding what to teach. Second by analysis of tasks, the task inventories provide a basis for specifying the knowledges and skills required to perform a job."[16]

After an examination of literature and a discussion about the meaning of a task, the members of the cluster concept research team formulated the following definition:

> A task describes the work performed by an individual in an occupation and consists of observable human behavior involving more than one areas of human requirement.

The areas of human requirement that may be involved in the performance of work by an individual in an occupation include:

a. Communications
    - vocabularly
    - symbols
    - drawings and blueprints
    - systems of communication
    - speech
    - English
    - maps

---

[15] Smith, op. cit., p. 14.

[16] Ibid.

b. Measurement
    - time
    - temperature
    - weight
    - volume
    - length, width, and depth
    - meters (electrical and mechanical)
    - instruments
    - systems of measurement

c. Skills
    - hand
    - mental
    - machine

d. Mathematics and Science

e. Information
    - technical
    - operational
    - occupational
    - economic
    - social
    - safety
    - personal hygiene
    - personal standards
    - occupational and job standards

Various sources indicated the importance of describing human behavior as clearly and concisely as possible in writing verbal descriptions of tasks. The Bureau of Naval Personnel stated that "task statements are...specific descriptions of work performed... that is, they tell "what" and "why" (and if important also: "when", "where", and "under what conditions".)[17]

Morsh, Madden and Christal stated that "generally a task is described by a statement consisting of a verb which expresses the action involved and a noun which is the object of the action.

---

[17] Bureau of Naval Personnel, op. cit., p. 15.

Modifiers and adverbs are used only when absolutely necessary for clarity of meaning."[18]

Mager, in his book on Preparing Objectives for Programmed Instruction, proposed the following items to describe terminal behavior that a learner will be doing:

a. Identify and name the over-all behavior act.

b. Define the important conditions under which the behavior is to occur (givens and/or restrictions and limitations).

c. Define the criterion of acceptable performance.[19]

Lindvall, in the following quotation, stated the importance of defining desired outcomes or specific objectives in behavioral terms.

> A first task of a team working on the development of a specific unit is to define exactly what pupils are to be expected to be able to do after they have mastered the unit. The emphasis here is on stating these objectives in terms of definite pupil behaviors. They are not to be stated in terms of what the teacher is going to do. They are not to describe learning activities. Each statement is to describe something that the pupil will be able to do after he has had the learning experience. Also they are not to be stated in such terms as "to understand...", "to master...", "to appreciate...", etc. Rather they are to tell what a pupil will be able to do if he understands, master, or appreciates. That is, they will be stated in terms of such pupil behaviors as "to explain...", "to state...", "to solve...", "to interpret...", "to compare...", "to list...", etc.[20]

---

[18] Joseph E. Morsh, Joseph M. Madden, and Raymond E. Christal, Job Analysis in the United States Air Force, Technical Report WADD-TR-61-113 (Lackland Air Force Base, Texas: Personnel Laboratory, Wright Air Development Division, February, 1961), p. 3.

[19] Robert F. Mager, Preparing Objectives for Programmed Instruc- (San Francisco, California: Fearon Publishers, Incorporated, 1962), p. 53.

[20] C. M. Lindvall, "A Report of the Regional Commission of Educational Coordination and the Learning Research and Development Center," Defining Educational Objectives (Pittsburgh: Pittsburgh Press, 1964) p. 13.

After reviewing literature in the area of task statement preparation, it was evident that a task should describe the work performed by an individual in a clear, precise, non-ambigious manner. To accomplish this objective, an attempt was made to write the tasks in behavioral terms that: (1) had complete validity or the same connotation from one individual to another, and (2) were conducive to observation and evaluation of the task performance.

The format of the task statements is shown in Figure 10. Each task statement began with a behavioral verb (A) which described the action involved in performing a task. The statement also included a noun (B) which described the object acted upon. Modifiers, such as adverbs and adjectives, were used in identifying the object acted upon. The result of the action (C) was stated which described the results of (A) and (B). Modifiers were used to clarify the results of the action and to specify the accuracy or limits that were required in the performance of the task. Whenever possible the task statement specified the accuracy that was required in the performance of the task.

E. Identification of Job Entry Tasks

A list of tasks, stated in behavioral terms, was prepared for each occupation in the three clusters. Task identification inventories were developed from these lists and submitted to a panel of occupational representatives at a conference held on April 27, 1966, at The University of Maryland. These representatives were selected from the areas of management and labor and included individuals who were supervisors, business owners, and union officials. The inven-

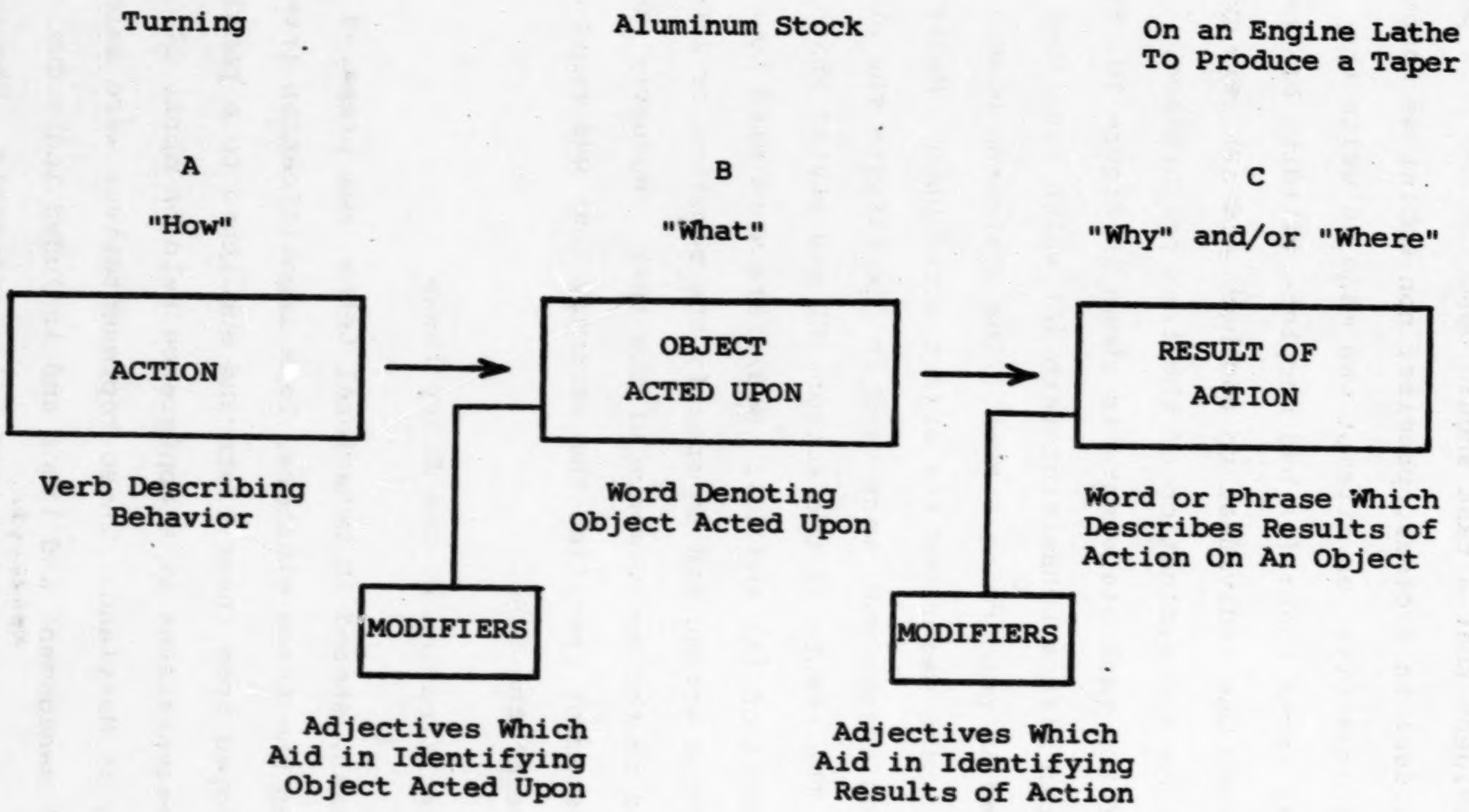
Turning
Aluminum Stock
On an Engine Lathe To Produce a Taper
A
B
C
"How"
"What"
"Why" and/or "Where"
ACTION
OBJECT ACTED UPON
RESULT OF ACTION
Verb Describing Behavior
Word Denoting Object Acted Upon
Word or Phrase Which Describes Results of Action On An Object
MODIFIERS
MODIFIERS
Adjectives Which Aid in Identifying Object Acted Upon
Adjectives Which Aid in Identifying Results of Action

Figure 10. Model for Writing Behavioral Statements

tory data was classified into three categories.

Level 0

> The task is not needed for the occupation and would not be included for further analysis.

Level 1

> The task is needed for entry into the occupation and will be included for further analysis.

Level 2

> The task is not needed for entry into the occupation but will be needed soon after entry and will be included for further analysis.

The identified job entry tasks for each occupation are included in the course outline volumes.

F. Identification of Common Areas of Human Requirement

After the job entry tasks were determined, the areas of human requirement (communication, measurement, mathematics, science, skills, and information) were identified that are required the performance of each task. Each statement of human requirement was prepared in behavioral terms. These statements were typed on small pieces of card stock, mounted on large boards, and coded according to the identified areas of human requirement.

The next step in the research was to identify the common areas of human requirement for each occupational cluster. A procedure, based on an approach proposed by Miller and Folley,[21] was developed to identify the common areas of human requirement for each occupational cluster. Each behavioral statement in an area of human requirement for an occupation was compared with the behavioral statements in similar areas of human requirement in the other occupations within the cluster. For example, the behavioral statement in the communication area "reading blueprints to determine size of parts" was compared with the behavioral statements in the communication area in other occupations within the cluster. A frequency tabulation was made to obtain the number of common behavioral statements for each area of human requirement that occurred within the occupational cluster. The frequency of commonalities was tabulated in the following areas:

---

[21] Miller and Folley, loc. cit.

1. Common to all occupations within the cluster.
2. Common to several but not all the occupations within the cluster

The results of this analysis, for each occupational cluster, are included in the course outline volumes.

The areas of human requirement that are common to the occupations included in each cluster have been identified in the task analysis sections of the course outline volumes with the following symbols:

Δ Common to all occupations within the cluster.

* Common to several but not all the occupations within the cluster.

ϕ Common within one occupation.

The completed task analyses and the identification of common areas of human requirement for each occupational cluster provided the basis for course outlines in the occupational clusters of: construction, metal forming and fabrication, and electro-mechanical installation and repair.

The results of the research will provide the content for the establishment of a pilot cluster concept program in vocational education at the secondary school level.

A request for a second year grant has been made for the purpose of preparing teachers for pilot cluster concept programs in several local secondary school systems. It is proposed that a third year grant will be made to implement the pilot programs in order to obtain some indication of the value of a cluster concept program in vocational education.

G. Summary

A review and analysis of the literature dealing with the identification of commonalities indicated that the use of mathematical techniques, such as factor analysis, were suitable for the identification of commonalities among a group of selected occupations. A decision was made, however, to investigate other techniques of identifying commonalities since the goal of the project was to develop suggested course outlines identifying commonalities in a cluster of occupations rather than explaining the commonalities in terms of a minimum number of hypothetical factors.

A research bulletin entitled The Development of Training Objectives was found applicable to the problem of analyzing the identified occupations in the clusters. A modified procedure, based on Smith's approach was developed to determine the areas of human requirement needed for successful performance in the occupations.

The initial step involved the development of task identification inventories which were submitted to representatives from management and labor in order to identify tasks that were required for job entry. The identified tasks were classified into three categories:

Level 0

> The task is not needed for the occupation and would not be included for further analysis.

Level 1

> The task is needed for entry into the occupation and will be included for further analysis.

Level 2

> The task is not needed for entry into the occupation but will be needed soon after entry and will be included for further analysis.

After the job entry tasks were determined, the areas of human requirement (skills, mathematics, measurement, science, communication, and information) were identified that were needed for the performance of each task. Each area of human requirement statement and each task statement was written in behavioral terms using an action verb to describe the behavior, a noun to describe the object of the behavior, and an adverbial or adjective phrase to describe the results of the behavior.

An analysis was then made to identify the common areas of human requirement for each occupational cluster. Each behavioral statement in an area of human requirement was compared with behavioral statements in similar areas of human requirement in other occupations within the cluster. A frequency tabulation was made to obtain the number of common behavioral statements for each area of human requirement that occurred within the occupational cluster.

The completed task analyses and the identified common area of human requirement provided the basis for the course outlines in the occupational clusters of: construction, metal forming and fabrication, and electro-mechanical installation and repair.

The course outlines that grew out of the study are included in three separate volumes of this report. There is one for each of the following: construction cluster, electro-mechanical installation and repair cluster, and metal forming and fabrication cluster. Each cluster area course outline is divided into a first and second level program. These separate volumes also include the following sections: job entry tasks, task analysis, an instructional sequence example, and the common areas of human requirement.

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Coombs, C. H. and G. A. Satter. "A Factorial Approach to Job Families." Psychometrika, 14:33-42, 1949.

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Morsh, Joseph E., Joseph M. Madden, and Raymond E. Christal. Job Analysis in the United States Air Force, Technical Report WADD-TR-61-113. Lackland Air Force Base, Texas: Personnel Laboratory, Wright Air Development Division, February, 1961.

Palmer, George J., and Ernest J. McCormick. "A Factor Analysis of Job Activities." Journal of Applied Psychology, 45: 284-289 August, 1961.

Smith, Robert G., Jr. *The Development of Training Objectives*, Research Bulletin No. 11. Alexandria, Virginia: Human Resources Research Office, 1964.

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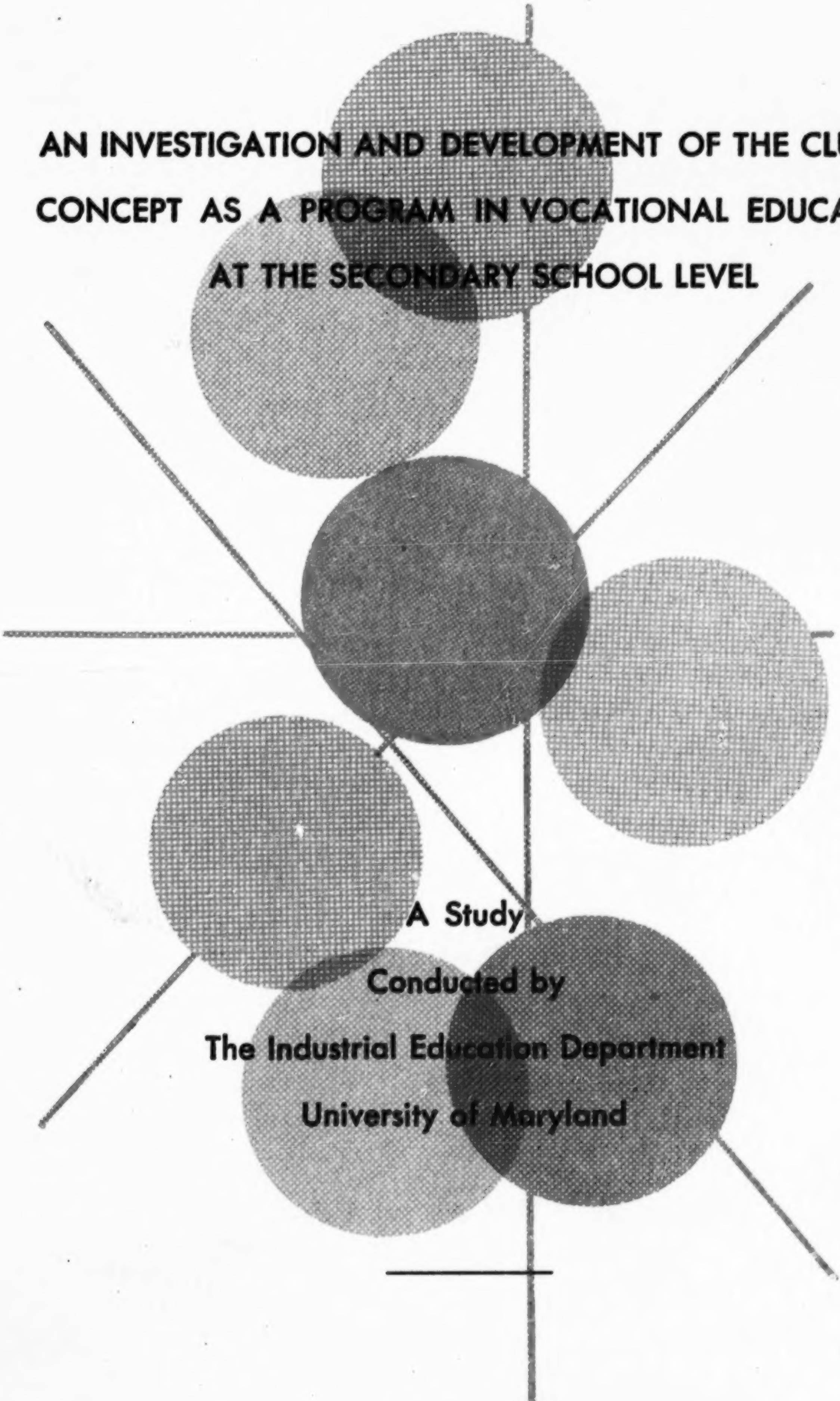
APPENDIX A

PROJECT BROCHURE



AN INVESTIGATION AND DEVELOPMENT OF THE CLUSTER CONCEPT AS A PROGRAM IN VOCATIONAL EDUCATION AT THE SECONDARY SCHOOL LEVEL

A Study
Conducted by
The Industrial Education Department
University of Maryland

1965 - 1966

PROBLEM There is a growing need in today's technical society for high school graduates to have training, skills, and understanding common to a number of related occupations. Students trained in specific skills are often limited in their choice of occupations and may lack the necessary qualifications for mobility in a changing technological environment.

PROPOSAL In order to provide an individual with greater occupational mobility, the *cluster concept* has been proposed as a program in vocational education at the secondary school level.

THE CLUSTER CONCEPT:

- is aimed at the development of potential employees having common skills and understandings related to a family of occupations.

- differs from the conventional vocational programs in terms of scope and depth. The usual vocational program is designed to prepare the individual for a specific job such as a patternmaker, auto mechanic, carpenter, or plumber. In the *cluster concept*, skills and understandings would be common to a number of occupations in a field. However, it would not be an in-depth development into any one job. This type of program would prepare the person to enter into a family of occupations rather than a specific occupation.

- might include the following examples of occupational groups or families:

Medical and Health

Home Facilities

Construction

Machining

Electricity and Electronics

Communications

Transportation

APPROACH The initial part of the study will address itself to the appropriateness of the *cluster concept* and will include:

- Acceptability of the product [the student] by industry or employing groups. This will be obtained by personal interview.
- Acceptability of such a program with school administrators.

The second part of the study will identify the cluster areas and the specific occupations in each area that would be appropriate for a *cluster concept* vocational program.

A series of cluster course outlines including resource and reference materials will be developed for specific cluster areas.

PROPOSED OUTCOMES The *cluster concept* program would prepare the student for:

MOBILITY

- within an occupational cluster
- on a geographical basis
- within industry or plant

A BROAD BASE OF TRAINING

- permitting a wider range of job entry opportunities

FLEXIBILITY

- in occupational choice pattern

OPPORTUNITY TO GAIN

- skill and understanding for job entry
- background for self appraisal of interests and potentialities

INCREASED EMPLOYMENT OPPORTUNITIES

- for individuals with low abilities

PROJECT TEAM

Principal Investigator

Dr. Donald Maley
Professor and Head
Industrial Education Department
University of Maryland
College Park, Maryland

Project Coordinator

Mr. Nevin Frantz

Research Assistants

Mr. Andrew Baron
Mr. Morris Lay
Mr. David Mills
Mr. Kenvyn Richards

Graduate Assistant

Mr. Richard Spahr

APPENDIX B

LETTER AND ADDRESSES OF INTERVIEW CONTACTS

UNIVERSITY OF MARYLAND
COLLEGE PARK

DEPARTMENT OF INDUSTRIAL EDUCATION
COLLEGE OF EDUCATION

Dear

Under the direction of Dr. Donald Maley, a research project in the Industrial Education Department of the University of Maryland has been approved by the U.S. Commissioner of Education under the title of "An Investigation and Development of the 'Cluster' Concept as a Program in Vocational Education at the Secondary School Level."

Enclosed you will find a copy of the brochure which explains briefly the "cluster" concept research program and its intended purposes and goals. It is our hope that you might aid us in this project by participating in an interview with one of the members of the research team. We would also appreciate talking with other individuals who might have some interest or information pertainent to the project. Because of the importance of this project to industry as well as education, we would be interested in ascertaining your views concerning the need and acceptability for such a program at the secondary school level as well as the employability of individuals who may pursue the proposed program. Your viewpoint will be of great importance in evaluating the feasibility of the "cluster" concept.

To retain accurate and reliable information, we would like to tape record your opinions on this project. All information will be held in strict confidence and will not be reproduced by any medium. If you are willing to participate in this project by allowing us to interview you, please check the enclosed card.

Thank you for your courtesy.

Sincerely yours,

Nevin R. Frantz

Nevin R. Frantz
Project Coordinator

NF/bw
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APPENDIX C

FORMAT FOR RECORDING DATA RECEIVED FROM INTERVIEWS

FORM FOR INDUSTRY

DATE______________________ INTERVIEWED BY____________________

ORGANIZATION

ADDRESS

PERSONS INTERVIEWED
  a. Name
  b. Title

PRODUCTS MANUFACTURED

NUMBER OF EMPLOYEES

OCCUPATIONS EMPLOYED

METHODS OF SELECTING AND REQUIREMENTS OF EMPLOYEES
  a. Tests
  b. Subjects and/or Requirements
  c. Unique Requirements
    (1) Physical Condition
    (2) Attitude
    (3) Other

REACTION TO THE CLUSTER CONCEPT PROGRAM

INFORMATION AVAILABLE
  a. Job Descriptions
  b. Foremen and Supervisors
  c. Future Visit?

OTHER COMMENTS

FORM FOR EDUCATION

DATE______________________ INTERVIEWED BY____________________

ORGANIZATION

ADDRESS

PERSONS INTERVIEWED
  a. Name
  b. Title

VOCATIONAL PROGRAMS OFFERED

NUMBER OF
  a. students (non-academic)
  b. teachers (vocational and/or Industrial Arts)

REACTION TO THE CLUSTER CONCEPT PROGRAM

PILOT PROGRAM POSSIBILITY

INFORMATION RECEIVED DURING THE INTERVIEW

OTHER AVAILABLE INFORMATION

OTHER COMMENTS

FORM FOR UNION

DATE____________________ INTERVIEWED BY____________________

ORGANIZATION

ADDRESS

PERSONS INTERVIEWED
- a. Name
- b. Title

NUMBER OF MEMBERS

OCCUPATIONS UNDER JURISDICTION

METHODS OF SELECTING AND REQUIREMENTS OF MEMBERS
- a. Tests
- b. Subjects and/or Requirements
- c. Unique Requirements
  - (1) Physical Condition
  - (2) Attitude
  - (3) Aptitude

REACTION TO CLUSTER CONCEPT PROGRAM

INFORMATION RECEIVED DURING INTERVIEW

OTHER INFORMATION AVAILABLE
- a. Job Descriptions
- b. Other

OTHER COMMENTS

FORM FOR EMPLOYMENT SECURITY

DATE____________________ INTERVIEWED BY__________________

ORGANIZATION

ADDRESS

PERSONS INTERVIEWED
   a. Name
   b. Title

NUMBER OF PEOPLE PLACED

OCCUPATIONS PLACED

METHODS OF PLACING PEOPLE
   a. Tests
   b. General Requirements for Employment in Industry
   c. Unique Requirements
      (1) Physical
      (2) Attitude
      (3) Aptitude
      (4) Other

REACTION TO CLUSTER CONCEPT PROGRAM

INFORMATION RECEIVED DURING INTERVIEW

OTHER INFORMATION AVAILABLE
   a. Job Descriptions
   b. Other

OTHER COMMENTS

APPENDIX D

LIST OF CONSULTANTS

The following is a list of people who have served as consultants for the Cluster Concept Project:

Mr. A.G. Beaubien
Chief
Registration and Review
Bureau of Apprenticeship and Training
U.S. Department of Labor

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Director
Training Department for
Apprentices and Journeymen
United Association of
Journeymen and Apprentices
of the Plumbing and Pipefitting Industry

Mr. Edmund Crosby
Assistant Professor
Industrial Education Department
University of Maryland

Dr. Paul DeVore
Director
Division of Industrial Arts
State University College
Oswego, New York
(Visiting Post-Doctoral Assistant
1965-66, University of Maryland)

Mr. A.B. Eckerson
Chief
Occupational Dictionary and Classification Section
Bureau of Employment Security
U.S. Department of Labor

Mr. Kenneth Guy
Instructor
Industrial Education Department
University of Maryland

Dr. Paul H. Harrison
Professor
Industrial Education Department
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Dr. Kenneth Hovet
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Dr. Joseph Luetkemeyer
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APPENDIX E

TASK IDENTIFICATION INVENTORY EXAMPLE

CLUSTER CONCEPT PROJECT

TASK IDENTIFICATION INVENTORY

****

I. **Information**:

1. Name____

2. Position______________________________________

3. Organization__________________________________

4. Address______________________________________

____

5. Number of years with present organization______________

6. Number of years worked in occupation__________________

****

II. **Directions**: On the following pages are listed a number of possible job-entry tasks associated with an occupation. Please review the list and add any tasks that you feel should be included. After you have reviewed the tasks and made any necessary additions, please review the list again and answer Question A listed on the question sheet. You will find a space in back of each task for placing the number which best answers Question A. When you have finished answering Question A for all the tasks go to Question B and finally answer Question C for each task. If you have any questions at any time, please feel free to call upon the research assistants working with you.

****

III. **Example**:

	Question A	Question B	Question C
Laying out sheet metal for cutting, bending, and joining straight line developments.			
Laying out sheet metal for cutting, bending, and joining cylinderical shapes.			

****

QUESTION SHEET

Question A: How soon after an employee has been hired is he required to perform the task?

(1) Within the first week.

(2) Later than the first week, but within the first month.

(3) Later than the first month, but within the first three months.

(4) Later than the first three months.

(5) Never required to perform the task.

Question B: How important is the task in accomplishing your organization's purpose?

(1) Of great importance.

(2) Above average importance.

(3) About average importance.

(4) Below average importance.

(5) Of little importance.

Question C: How difficult is it for your organization to conduct on-the-job training for this task?

(1) No difficulty at all.

(2) A few difficulties that can be overcome with ease.

(3) Several difficulties that can be overcome with some effort.

(4) Many difficulties that can only be overcome with great effort.

(5) Practically impossible.

MASON'S TASKS

	Question A	Question B	Question C
Erecting batter boards at corners of excavation for a building			
Setting up a work area in order to expedite the mixing of concrete on the job			
Cleaning and oiling concrete forms prior to and after use on a building.			
Constructing a box for measuring materials used in mixing cement			
Constructing a form for patio blocks			
Constructing a form for sidewalk block			
Setting a section of sidewalk form to receive concrete at a building site			
Shoring sidewalls of earthen ditches to prevent cave-ins during excavation			
Installing footer forms to receive concrete for a foundation			
Setting a pier footer form to receive concrete.			

	A	B	C
Installing rods and spreaders to space form sections before pouring			
Wiring and bolting forms to prevent spreading during pouring			
Bracing sidewalls of forms to prevent spreading during pouring			
Preparing a batch of - lime mortar cement cement-lime mortar patented mortar plaster -by hand and by machine, at the construction site			
Pouring concrete for a section of a sidewalk			
Pouring a section of footing containing reinforcing roo for a house			
Pouring a small reinforced concrete slab suitable for a porch deck on a house			
Installing anchor bolts in masonry walls while pouring for a house			
Embedding bolts in concrete to provide a place for securing future construction			
Finishing a small concrete slab to provide utility and pleasing appearance			

	A	B	C
Protecting a concrete slab following finishing operations to provide for proper curing			
Erecting scaffold for use by a mason at the building site			
Preparing brick for use by the mason on a house			
Cutting a flue tile to length for a chimney in a house			
Laying cement block for a wall in stretcher courses for a building			
Pointing up a section of a brick wall to provide a finished appearance on a house			
Cleaning out mortar joints for tuck-pointing on a masonry wall			
Removing efflorescence from brick or stone facing to improve appearance of the masonry			
Applying colorless coating to waterproof masonry surfaces above grade on a building			
Applying asphalt coating to waterproof foundation walls below grade on a building			

APPENDIX F

DEFINITIONS OF BEHAVIORAL VERBS

The following pages include a list of verbs used in describing the behavior required for all of the occupations included in the three occupational clusters.

Adhering - to join parts together with the use of adhesives.

Adjusting - to bring to a satisfactory condition.

Aligning - to adjust, form, or bring to a line.

Allowing - to supply in a fixed regular quantity.

Applying - to put into use specific information and objects that will be required to complete a task.

Arranging - to put into proper order, to adopt.

Assisting - to lend aid or help, to give support to.

Assembling - to fit together the parts of by one or more fastening methods.

Attaching - to bind, to fasten; to connect or to adhere.

Backfilling - to refill as in replacing excavated earth.

Bending - to turn or force from straight or even to curved or angular.

Beveling - to cut or shape to an incline or slant.

Blocking off - to close off in order to prevent passage.

Blowing - to remove foreign particles from an object through the use of compressed air.

Bolting - to fasten or secure with a bolt or bolts.

Boring - to machine a recessed hole enlarging that hole to specific dimensions.

Bracing - to fasten tightly, to draw tight or into a state of tension; to support so as to give firmness.

Brazing - to make an adhesion connection with a minimum of alloy which melts above 800 degrees F. and which flows by capillary between close-fitting parts.

Calculating - to determine by mathematical processes, figure out.

Charging - to lay or put a load on or in.

Checking - to insure correctness.

Clamping - compress, to fasten.

Cleaning - to make free from foreign matter.

Cleaning out - to remove residue and make free from obstruction.

Comparing - to examine the character or qualities of; especially to discover resemblances or differences.

Computing - to make calculations by mathematical means.

Connecting - to join, fasten, connect, unite or link together.

Constructing - to put together the parts of; to build.

Converting - to turn around, transform, to change from one form or function to another.

Counterboring - to enlarge a hole to a given depth and diameter.

Countersinking - to chamfer a hole to receive a flat-head screw.

Covering - to afford protection against or compensation for.

Cutting - to divide into parts with an edged tool.

Demonstrating - to show clearly, to prove or make clear by reasoning or evidence.

Describing - to represent or give an account of in words.

Determining - to fix conclusively, to settle or decide by choice of alternatives or possibilities.

Diagnosing - to identify the cause or nature of a condition, from its signs or symptoms.

Digging - to turn up, loosen, or remove earth.

Disassembling - to break down, take apart.

Discharging - to relieve of a charge, load or burden, to emit or give vent to.

Disconnecting - to sever the connection of or between.

Drawing - to create a likeness or a picture in outline, to communicate an idea.

Dressing - to make or set straight, to put in order for use or service.

Drilling - to cut round holes by use of a cutting tool sharpened on its point.

Driving - to impart a forward motion to by physical force.

Edging - to smooth and round as in finishing the edge of a concrete slab while plastic.

Eliminating - to set aside as unimportant.

Embedding - to lay in surrounding matter, to bed.

Erecting - to raise, to build.

Evacuating - to make empty, to discharge through passages.

Exercising - to bring to bear, to use repeatedly in order to strengthen or develop, to exert influence.

Explaining - to make plain or understandable, to give the reason for or cause of.

Fastening - to attach, to make fast and secure.

Figuring - to calculate the value of something.

Filing - to remove excess metal with the use of a file.

Filling - to raise the level of with fill.

Finishing - to bring to an end according to specifications.

Flaring - to open or spread outward.

Flashing - to protect against rain, as the valley, hip, or edge of roof, by sheet metal or a substitute, laid under or over the roofing or as in the case of doors and windows, to prevent water from getting underneath the siding.

Flame cutting - a process of severing ferrous metal by means of the chemical action of oxygen on the metal at high temperatures using a torch for controlling the gases used for preheating and the oxygen for severing the metal.

Following - to watch steadily.

Forming - to shape metal to a desired form.

Framing - to construct as a building, by fitting and uniting the parts of a skeleton.

Glazing - to furnish or fit (a windown, a sash, etc.) with glass, to include installation of glazing compound.

Grinding - to remove excess material by pressing it against a rotating grinding wheel.

Grounding - to make proper electrical connection necessary in grounding a circuit.

Hammering - to strike repeated blows as with a hammer.

Handling - to touch, hold or otherwise affect with the hand.

Hanging - to put into as much as can be held or conveniently contained.

Holding - to maintain a grasp on.

Identifying - to establish the identity of.

Inserting - to put or thrust in.

Inspecting - to view closely in critical inspection.

Installing - to set up or establish for use.

Insulating - to separate from conducting bodies by means of nonconductors, as to prevent transfer of electricity, heat or sound.

Isolating - to set apart from others.

Interpreting - to explain the meaning of.

Joining - to connect physically into a unit.

Keeping - to preserve for future provision.

Knurling - the operation that presses grooved, hardened steel wheels (knurls) into the surface of cylindrical work rotating in the lathe, to produce rows of uniformly spaced serrations which provide a better grip, or for decorative purposes.

Lapping - to place over or next to so as to partially or wholly cover.

Laying - to put down or to put in place, apply.

Laying out - to prepare material for subsequent work operations.

Leveling - to make (a line or surface) horizontal, to make flat or level.

Lighting torch - to ignite the gas mixture at the nozzel of the torch by a spark lighter.

Listening - to pay attention to sound.

Locating - to place within required limits.

Lubricating - to apply a substance capable of reducing friction, heat and wear.

3

Machining - to turn, shape, plane, mill, drill or otherwise reduce or finish by machine operated tools.

Marking - to determine the boundaries of, to designate as by a mark.

Mating - to match or couple.

Measuring - to ascertain the capacity or quantity as prescribed by established standard.

Milling - to remove metal with a rotating cutter on a milling machine.

Mixing - to combine or blend into one mass.

Mounting - to attach in place.

Nailing - to fasten with a nail.

Necking - to machine a groove on a lathe around a cylindrical shaft.

Observing - to inspect or take note of.

Offsetting - to place over against, balance, to compensate for.

Oiling - to apply oil to prevent adhesion.

Opening - to make available for entry or passage by turning back, removing, or clearing away.

Operating - to put into action.

Parting - to cut pieces on a lathe with a parting tool.

Placing - to put into a particular spot, to assign to a position.

Plugging - to make tight, or secure by inserting a plug.

Plumbing - to adjust or test by a plumb line; to cause to be perpendicular.

Pointing up - to finish a wall by filling the joint with cement, mortar, or other material after the wall is built.

Positioning - to put in proper position.

Pouring - to cause or allow to flow in a stream.

Practicing - to actually perform or apply knowledge.

Preheating - to heat beforehand.

Preparing - to fit, adapt, or qualify beforehand for a particular purpose, end, or condition; to make ready; to put into a state for use or application.

Preserving - to keep safe from injury, harm, or destruction.

Preventing - to be in readiness for, to keep from happening.

Protecting - to guard or shield from injury.

Providing - to take precautionary measures, to supply what is needed for substenance or support.

Puddling - to compact or condense as with concrete to eliminate air bubbles.

Punching - to emboss, cut, perforate, to strike or press sharply.

Putting - to place in a specified position or relationship.

Raising - to set upright by lifting or building.

Reading - to perceive the meaning of symbols.

Reaming - to finish a drilled hole to exact size with a reamer.

Re-assembling - to fit together parts which have been together before.

Receiving - to take or come into possession of.

Recognizing - to perceive something previously known.

Regulating - to fix or adjust the time, amount, degree, or rate of.

Resealing - to secure with a closure against access or leakage in an area that had previously been sealed.

Removing - to change the location of.

Repairing - to restore to a sound state after decay, injury, delapidation or partial destruction. To renew, revive or rebuild.

Replacing - to restore an operating unit for a defective unit.

Resurfacing - to provide with a new or fresh surface.

Restarting - to start anew, to resume operation.

Re-testing - a procedure used to identify a condition to evaluate the operation of.

Rewiring - to wire anew.

Riveting - to fasten or secure with a rivet.

Running a bead - the process in welding of depositing or fusing metals along edges to be joined.

Sanding - to smooth by rubbing with an abrasive.

Saving - to preserve or guard from injury, destruction.

Scraping - to remove (excrescent matter) from a surface by usually repeated strokes of an edged instrument.

Scribing - to mark a line on by scratching with a pointed instrument.

Sealing - to secure with a closure against access or leakage.

Securing - to make fast.

Selecting - to choose from a group.

Servicing - to perform maintenance, supply, and repair work.

Setting - to put in desired position, adjustment or condition.

Setting up - to institute, establish and found, to put in operation, to organize.

Shutting off - to interrupt or stop.

Shoring - to support by shores or shore; to prop; to slope; shelve.

Soldering - to fasten metals together by adhering another metal to the two pieces of metal.

Softening - to make soft or softer.

Splicing - to unite by twisting together.

Spot facing - to machine a circular spot on the surface of a part to furnish a flat bearing surface for the head of a bolt or nut.

Spraying - to disperse or apply a spray.

Squaring - to make square or rectangular, to test for deviation from a right angle.

Staggering - to arrange in alternations or overlappings of position.

Stamping - to impress with some mark or design.

Stirring - to mix liquids with a paddle.

Stopping - to bring to a halt, to cease.

Storing - to lay away, to leave or deposit in a place for preservation or disposal.

Straightening - to make or become straight.

Striking an arc - to cause an electric arc to fire from the electrode to the metal work piece.

Tacking - small weld used to temporarily hold together components of an assembly.

Tamping - to drive in or down by a succession of light or medium blows.

Tapping - to produce internal threads with a tap.

Testing - to identify a condition, to evaluate the operation of.

Threading - to form a screw thread on or in.

Throwing - to propel through the air in some manner, as with a trowel in applying mortar to a concrete block.

Tightening - to hold, bind, or fix securely or firmly.

Tinning - to apply a coating of solder to the metals to be soldered, or to the soldering copper.

Tracing - to copy by following a pattern.

Troweling - to smooth, mix, or apply with a trowel.

Truing - to make level, square or concentric.

Turning - to cause to move around an axis or center.

Twisting - to cause to move with a turning motion.

Tying - to fasten, attach or close by means of a tie, to form a knot.

Unrolling - to unwind a roll, open out.

Unsoldering - to remove solder from a soldered joint with the use of heat.

Utilizing - to make use of.

Ventilating - to expose to air and especially to a current of fresh air for purifying, curing, or refreshing.

Washing - to cleanse by action of a liquid.

Wearing - to bear or have upon the person, the act of wearing.

Welding - to fasten metals together by means of interfusing the metals.

Wetting down - to make wet.

Wiring - to furnish, bind, attach, string, set up, mount, etc. with wire.

Writing - to draw or form by scaring or incising a surface.

Yarning - to place and pack a filler such as oakum in a pipe joint.